WYC SF 5.4.4.4
WYC AR 2.6

Appendix K
Technical Memorandum
Ecological and Human Health Risk Assessments
Pacific Sound Resources Marine Sediments Unit

Volume II

EPA REGION X

Contract No. 68-W9-0046
Work Assignment No. 46-37-0M2L
Work Order No. 4000-31-01-5000-06/-05
Document Control No. 4000-31-01-AABV

April 1998

512

WESTON
MANAGERS DESIGNERS/CONSULTANTS

TECHNICAL MEMORANDUM
Ecological and Human Health
Risk Assessments
Pacific Sound Resources Marine Sediments Unit

Prepared for
U.S. Environmental Protection Agency
Region X
1200 Sixth Avenue
Seattle, Washington 98101

Contract No. 68-W9-0046
Work Assignment No. 46-37-0M2L
Work Order No. 4000-31-01-5000-06/-05
Document Control No. 4000-31-01-AABV

April 1998

Prepared by
Roy F. Weston, Inc.
700 Fifth Avenue
Suite 5700
Seattle, WA 98104-5057

TABLE OF CONTENTS

TABLE OF CONTENTS (*Continued*)

TABLE OF CONTENTS (*Continued*)

Section Page

LIST OF TABLES

Table

LIST OF TABLES (*Continued*)

Table

LIST OF TABLES (*Continued*)

Table

LIST OF TABLES (*Continued*)

Table

LIST OF FIGURES

RI = Figure occurs in RI report.

EXECUTIVE SUMMARY

INTRODUCTION

This technical memorandum presents the results of the human health and ecological risk assessments conducted as part of the Remedial Investigation (RI) for the Marine Sediments Unit (MSU) at the Pacific Sound Resources (PSR) in Seattle, Washington (RI Figure 1-1). The PSR site was divided into two units: the Upland Unit and the MSU. From 1909 until 1994, the Upland Unit operated as a wood-treating facility where historical storage, handling and disposal of treated wood, process residuals and chemical preservatives resulted in the release of creosote, pentachlorophenol, and other related chemicals to the marine environment in the southwest portion of Elliott Bay (as represented by the MSU).

The Upland Unit has undergone extensive remediation under an EPA/Port of Seattle (Port) Administrative Order as part of the Port's Terminal 5/Southwest Harbor expansion project. The upland actions resulted in little or no risk to people or animals visiting the Upland Unit. Therefore, the human health and ecological risk assessments were conducted to evaluate the potential for current and future impacts of site-related contaminants on receptors (including people) inhabiting or visiting the MSU. Risks were estimated as "residual risks," or the risks remaining after a given area of the MSU is remediated. Baseline risks, or those risks that currently exist at the MSU, were also calculated to determine reductions in risk for several cleanup scenarios.

SITE CHARACTERIZATION AND CONCEPTUAL SITE MODEL

The PSR Upland Unit is a former wood-treating facility located on the southern shore of Elliott Bay. The area surrounding the PSR site is heavily industrialized with many facilities linked to water-dependent industries. The upland portion of the PSR site is currently being redeveloped by the Port as an intermodal railyard for container shipping. As part of the Port's redevelopment, a public access corridor for walking, jogging and biking is being constructed along the shoreline area of the site. In addition, the main pier will be retained as a public view point. However, both the shoreline and the pier will be fenced to prevent land-based access to the shoreline and Elliott Bay. Water-dependent recreational activities in the vicinity of the site, including fishing and crabbing, will be limited to boat access only.

Nearly all intertidal wetlands and shallow subtidal aquatic habitats in the vicinity of the MSU have been eliminated as a result of urban and industrial development. Limited intertidal habitat exists within the MSU in the form of two pocket beaches at the head of the West and Main Slips and thin bands of mud- and sandflats along the toe of the riprap shoreline banks. Because the MSU is located in a transition zone between the estuarine environment of the Duwamish River and the marine environment of Elliott Bay, the substrates and waters adjacent to the site contain habitat characteristics common to both environments. Biota utilizing the habitat within the MSU include a variety of marine invertebrates, fishes (including salmonids), birds, and marine mammals. Some of the potential inhabitants are listed as state and federal species of concern. People who are most likely to come into contact with contaminated media in the MSU are tribal fishers (Elliott Bay is part of the traditional fishing grounds for the Muckleshoot and Suquamish tribes) and recreational fishers, including those that harvest crab or shrimp.

Based on the conceptual site model developed for the PSR site, sediment represents the primary impacted environmental medium in the MSU under current conditions. Furthermore, this medium tends to retain contaminants and can act as a source of contaminant exposure for various receptors under future conditions. Receptors that may come into contact with sediment include benthic organisms (e.g., clams), free-living shellfish (e.g., crabs and shrimp), fish, birds, and people fishing or crabbing in the nearshore area. Because of the completed cleanup actions at the Upland Unit, potential upland site-related sources of contaminants and associated pathways (e.g., surface water runoff) are expected to be controlled and to no longer contribute to contamination in the MSU; these historical exposure pathways were thus not evaluated as part of the risk assessments.

RISK ASSESSMENT FOCUS

The human health risk assessment evaluated potential cancer and non-cancer risks to subsistence fishers, as represented by tribal fishers, who may consume above average amounts of fish and shellfish from the site. Estimates of the amount of fish and shellfish that may be eaten by tribal fishers were derived from a seafood consumption study for two Puget Sound tribes (Toy et al., 1996).

Benthic invertebrates (represented by several benthic species, including clams, amphipods, and sanddollars), bottom fish (specifically English sole), and fish eggs were selected for the ecological risk assessment, as these species were considered representative of site exposures and have demonstrated sensitivities to a wide range of chemicals (including those potentially released from the PSR site). The evaluation of the health of benthic invertebrate communities was based on multiple effects measures, including sediment toxicity bioassays, *in situ* benthic community structure, and clam tissue bioaccumulation data. The evaluation of the health of bottom fish populations was based on fish tissue bioaccumulation data and the use of a simple linear model to estimate the transfer of bioaccumulative contaminants from a fish to its eggs.

IDENTIFICATION OF POTENTIAL CLEANUP AREAS

Based on the results of sampling events conducted in 1996 as part of the RI, it was demonstrated that polycyclic aromatic hydrocarbons (PAHs), particularly low molecular weight PAHs, displayed a widespread distribution in the MSU at concentrations exceeding Washington State Sediment Management Standards (SMS) or Puget Sound Apparent Effects Threshold (AET) screening values. PAHs were therefore selected as indicator chemicals for identifying potential cleanup areas. For the purposes of the risk assessments, the areas identified in the RI as exceeding the SMS and/or AET screening values were used as the basis for the residual risk calculations. These potential cleanup areas were differentiated by: (1) those that exceeded the numerically lower screening criteria [i.e., SMS Sediment Quality Standards (SQS) or lowest AET values (LAETs)]; and, (2) those that exceeded the numerically higher screening criteria [i.e., SMS Cleanup Screening Levels (CSLs) or second-lowest AET values (2LAETs)]. Baseline risks, or those risks that currently exist at the MSU, were also calculated to determine reductions in risk for several cleanup scenarios.

CONTAMINANT SELECTION

Contaminants evaluated in the risk assessments were chosen separately for human and ecological receptors. Contaminants were selected to focus the assessment on those chemicals of greatest potential concern in the MSU (PAHs, dioxins, and furans). Contaminants carried forward in both risk assessments included those site-related chemicals that exceeded SMS criteria or were known to bioaccumulate, that were widespread throughout the site, and that exceeded Elliott Bay background concentrations. Additionally, contaminants were retained for the human health risk assessment only if they exceeded risk-based screening values or if screening values were not available.

EXPOSURE ASSESSMENT

The exposure assessment for human health focused on exposure of tribal fishers to site contaminants through consumption of fish and shellfish from the MSU site. Both an average tribal fisher scenario and a reasonable maximally exposed (RME) tribal fisher scenario were evaluated to show the range of potential risks at the site. English sole collected from the MSU were used as surrogate species to represent bottom fish because of their abundance at the site, extensive contact with sediment, and limited home range. Clams were used as a surrogate species for all shellfish because of their close association with sediment and potential for human consumption. The human health risk assessment used consumption rates and patterns determined from a seafood consumption survey of the Tulalip and Squaxin Island tribes. Modifications were made to reflect reasonable expected consumption of fish and shellfish from the MSU. Fish and shellfish exposure point concentrations for evaluation of human health risks under current conditions and various cleanup scenarios were determined using a linear bioaccumulation model.

The ecological exposure assessment focused on deriving exposure point concentrations for sediment, benthic infauna, clams, fish, and fish eggs. Contaminant-specific exposure point concentrations for surface sediment and benthic exposures were evaluated on a station-by-station basis. Exposure of clams and fish to site-related contaminants was estimated by directly measuring concentrations in tissues. A maternal-egg transfer model was used to estimate fish egg exposure.

TOXICITY ASSESSMENT

The human health toxicity assessment focused on the relationship between exposure and potential for adverse health effects. Cancer risks due to site exposure were evaluated based on EPA toxicity factors; non-cancer risks were evaluated based on published reference doses. Of the site-related COPCs in fish and shellfish that were of concern for human health, only dioxins and some PAHs were considered to be carcinogenic. The cancer risks posed by these compounds were evaluated using EPA's toxicity equivalency factors approach. A non-cancer reference dose was identified for only one PAH.

In the ecological risk assessment, several different criteria were used to evaluate potential toxicity to a range of receptors at the site. Potential toxicity to benthic organisms was evaluated by comparing site-specific sediment chemical and biological data (including laboratory bioassays) to effects-based screening criteria (e.g., SMS), as well as benthic community-based indices to Elliott Bay background data.

Chemical-specific toxicity evaluations were conducted for measured concentrations of COPCs in fish collected from the site and in clams exposed to site-collected sediment. Estimates of fish egg concentrations were made based on a simple maternal transfer model. Toxicity to fish and eggs was also evaluated using literature-based effects concentrations of chemicals in fish tissues and background concentrations of chemicals in clam tissue.

HUMAN HEALTH RISK CHARACTERIZATION

Results of the human health risk assessment suggest that cancer risks to subsistence fishers are of primary concern under current conditions. Cancer risks represent an individual's chance of developing cancer due to ingestion of seafood from the MSU, over and above those exposures associated with general activities in a lifetime. Under current conditions, total cancer risks for the RME individual (high end tribal fisher) are four in ten thousand (4E-4). These risks are reduced by nearly an order of magnitude (to 7E-5) following sediment remediation to CSL concentrations, and by half the remaining risk (to 2E-5) following sediment cleanup to SQS concentrations. No additional reduction in risk occurs if the entire site is remediated. The SQS- and CSL-based cleanup scenarios would result in residual risks within EPA's risk management range (1E-4 to 1E-6), but greater than Washington State MTCA guidance (1E-5).

Under current conditions, noncancer hazard indices based on exposure to PAHs are less than 1.0 for both adults and children, indicating that non-cancer effects for these chemicals are likely minimal for the site.

ECOLOGICAL RISK CHARACTERIZATION

The results of the ecological risk assessment indicated no risks to fish or fish eggs based on exposure to bioaccumulative contaminants (i.e., dioxins and furans) in sediment, but that existing PAH contamination has low to moderate impacts on benthic invertebrates residing in the MSU. Deleterious impacts to clams from exposure to site-related contaminants may also be occurring. However, the majority of the stations at which benthic impacts were identified would be reduced to no risk if a CSL-based sediment cleanup was implemented.

PAHs in sediment may also be affecting fish health based on the strong link between exposure to chlorinated hydrocarbons (such as PAHs) and such effects as development of tumors and lesions, suppressed immune response, or impaired cortisal stress response. This risk was not quantified as part of this risk assessment because PAHs are readily metabolized by vertebrates and are not retained in tissues, making it difficult to link exposure to specific sediment concentrations (directly or via ingestion of contaminated prey) to effects. Based on limited information in the literature regarding the relationship of sediment concentrations to fish effects, it appears that significant deleterious impacts can occur at PAH concentrations several times to an order of magnitude lower than the concentrations that cause effects in benthic invertebrates. Given that this range of concentrations is similar to the levels in sediment that would be protective of people eating shellfish, cleanup decisions based on human health issues will likely protect fish.

SECTION 1

INTRODUCTION

This technical memorandum presents the human health and ecological risk assessments prepared for the Marine Sediments Unit of the Pacific Sound Resources (PSR) Superfund Site in Seattle, King County, Washington (see **Figure 1-1** in the Remedial Investigation [RI] report). This memorandum was prepared for the U.S. Environmental Protection Agency (EPA) by Roy F. Weston, Inc. (WESTON) under Work Assignment 46-37-0M2L, dated 2 May 1995. The draft technical memorandum was submitted to EPA and other reviewing agencies on 22 September 1997 and revised herein according to regulatory and trustee agency comments received in November 1997.

The PSR site has been divided into two units: the Upland Unit and the Marine Sediments Unit (MSU). The MSU represents the offshore receiving environment for historical releases of wastes from the upland facility. Contamination of the MSU is directly linked to past operations at the Upland Unit. The Upland Unit was a former wood-treating facility, which operated exclusively for this purpose between 1909 and 1994. Wood-treating operations included vacuum treatment of wood products to remove air from wood cells and pressure cooking in heated preservatives. Preservatives most commonly used included creosote and creosote/fuel oil mixtures, pentachlorophenol (PCP), and Chemonite (also known as ACZA, a mixture of ammoniacal zinc, copper, and arsenic). Zinc meta-arsenate, chromated zinc chloride, Wolman salts (containing fluoride, chromium, arsenic, and phenol), and Pyresote (made of zinc chloride, boric acid, ammonium sulfate, and dichromate) also had documented use at the site (WESTON 1996b). Releases of contaminants to the MSU likely occurred as part of the disposal practices for tank sludges, draining of retorts, transfer and storage of freshly treated logs on piers, and spills or leaks from storage tanks.

The Upland Unit has undergone extensive remediation under an EPA/Port of Seattle Administrative Order as part of the Port's Terminal 5/Southwest Harbor expansion project. Upland cleanup activities included removal of creosote-saturated soils, construction of a deep (up to 50 feet below ground surface [bgs]) slurry wall around the source areas, installation of a light nonaqueous phase liquid (LNAPL) interception trench, and filling and paving of the site. These actions resulted in little or no remaining risk to people working in or animals visiting the Upland Unit. Therefore, the human health and ecological risk assessments were conducted to evaluate the potential for current and future impacts of site-related contaminants on receptors (including people) inhabiting or visiting the MSU.

The nature and extent of surface sediment chemical contamination in the MSU was evaluated as part of the PSR RI (WESTON 1998). As part of that assessment, surface sediment PAH data were compared with SMS SQS (or LAET) and CSL (or 2LAET) chemical criteria to define areas of the MSU that may require cleanup. PAHs were selected as indicator chemicals for identifying potential cleanup areas because of their widespread distribution at elevated concentrations. The areas of the site at which PAHs exceeded their respective sediment chemical screening criteria are depicted in **Figure 5-14** in the RI.

The overall approach for both ecological and human health evaluations focused on risks associated with site-related chemicals following cleanup of areas identified as exceeding SQS/LAET and CSL/2LAET chemical criteria. It is currently anticipated that much of the nearshore area of the site will be actively remediated based on clear exceedances of Cleanup Screening Levels (CSLs) by site-related chemicals in sediment. Different cleanup scenarios using the SMS criteria as remedial action goals are being evaluated as part of the Feasibility Study. The risks estimated in this technical memorandum represent what are termed "residual risks," or the risks remaining after a given area of the MSU has been remediated. Baseline risks, or those risks that currently exist at the site, were also calculated to determine reductions in risk for several cleanup scenarios.

Data supporting the risk assessments were derived from sediment, fish, and clam tissue samples that were analyzed as part of two field efforts conducted in 1996 and one field effort in 1997. During Phase 1 (April 1996) surface (0 to 10 cm) sediment samples were collected at 44 locations and analyzed for various chemicals (i.e., selected metals, PAHs, dioxins and furans, phenols, dibenzofurans and PCBs) potentially related to Upland Unit activities. Phase 2 (September/October 1996) was a more extensive sampling effort and involved collection and analysis of surface sediment at an additional 39 locations and fish tissues from two offshore areas. Four background areas within Elliott Bay and a reference area in Carr Inlet were also sampled as part of these efforts. Sediments collected from nine locations within the MSU were used to conduct two acute sediment toxicity bioassays (amphipod mortality and echinoderm embryo developmental abnormality) and a laboratory clam bioaccumulation and growth test. Benthic infaunal invertebrate community structure was also evaluated from the same nine locations where bioassays were conducted. Phase 3 (July 1997) was conducted to resolve the extent of surface sediment contamination. Thirty-one samples were collected at the outermost bounds of the MSU as defined by Phase 2 sediment chemistry. Approximately half of these samples were initially analyzed and those remaining were archived. Based on these results, another eight were analyzed to complete the extent evaluation. **Figure 1-4** in the RI shows the Phase 1, 2, and 3 MSU sampling locations. MSU fish trawl locations are depicted in RI **Figure 1-5**. All sediment chemistry data are provided in their entirety in the RI report (WESTON 1998). Biological effects data are reported herein.

The human health and ecological risk assessments are organized in nine sections:

1) *Introduction.* Section 1 provides an overall description of purpose and content of this document.

2) *Site Characterization and Conceptual Site Model.* Section 2 describes the various environmental components of the ecosystem comprising the MSU and vicinity, the media

and receptors selected for evaluation, and the conceptual site model proposed for the MSU.

3) *Contaminant Selection.* Section 3 describes the analytical data used, summarizes the results of screening steps used in prioritization of contaminants, and selects the contaminants of potential human health and ecological concern for evaluation.

4) *Exposure Assessment.* Section 4 identifies the potential human and ecological receptors and exposure pathways for the MSU and calculates the exposure point concentrations to be used in the risk assessments.

5) *Toxicity Assessment.* Section 5 describes the toxicity of chemicals within the MSU to human and selected ecological receptors and identifies effects levels to be used in the risk evaluations.

6) *Human Health Risk Characterization and Uncertainties.* Section 6 estimates baseline and residual risks to human receptors for the MSU and associated uncertainties.

7) *Ecological Risk Characterization and Uncertainties.* Section 7 estimates baseline and residual risks to ecological receptors within the MSU and associated uncertainties.

8) *References.* Provides complete citations for all referenced documents.

Attachments K.1 through K.9 contain supplemental information in support of the risk assessments. Attachments include:

- Benthic infaunal data
- Life histories for ecological receptors
- Ecological risk calculations
- Benthic endpoint deviation procedures and statistical methods
- Statistical outputs supporting benthic risk characterization
- Bioassay data
- Fish tissue data
- Clam tissue data
- Elliott Bay background surface sediment data.

SECTION 2 TABLES

SECTION 2

SITE CHARACTERIZATION AND CONCEPTUAL SITE MODEL

2.1 CHARACTERIZATION OF MARINE SEDIMENTS UNIT

This section describes the different types of habitats that may be present in the MSU and the receptors (including different groups of people and animals) that may utilize those habitats. This information was used to identify the human populations and living natural resources that may be adversely affected by site-related contaminated sediment.

2.1.1 Land Use

The PSR MSU is located in the southwestern portion of Elliott Bay (see RI **Figure 1-1**), a deep, cold-water harbor located in east-central Puget Sound. Elliott Bay has been extensively developed for urban, port, and industrial land uses. The area surrounding the PSR site is heavily industrialized with many facilities linked to water-dependent industries. The upland portion of the PSR site is currently being redeveloped by the Port of Seattle as an intermodal railyard for container shipping. This new facility extends from the West Waterway to the western PSR property boundary and south to approximately the West Seattle freeway. The adjacent property west of the site (Crowley Marine) continues to operate as a barge transport facility for bulk materials.

2.1.1.1 Recreational Use

In addition to urban industrial uses, Elliott Bay is also the site of many water-dependent recreational activities including sailing, boating, scuba-diving, parasailing, fishing, shrimping, and crabbing. Intertidal habitat is extremely limited in the bay and at the PSR site, so digging for clams is not a common activity. Because of the industrial character of the PSR site, no recreational opportunities exist in the shoreline area, with the exception of fishing or crabbing, which would occur by boat access only. The nearest public access point is the Don Armeni boat launch about 0.5 mile northwest of the site. As part of the Port's redevelopment of the site, a public access corridor for walking, jogging, and biking is being constructed along the shoreline area of the site. The main pier at PSR will be retained as a public view point. However, both the shoreline and the pier will be fenced to prevent access to the shoreline and Elliott Bay.

2.1.1.2 Tribal Use

Elliott Bay, including the area in the vicinity of the PSR site, is part of the traditional fishing grounds for the Muckleshoot and Suquamish tribes. Tribal members engage in net fishing for salmon during seasonal runs.

2.1.2 Habitat

Environmental investigations in the MSU have focused on sediment extending from the toe of the bank to the offshore subtidal areas because the PSR shoreline consists primarily of riprap. Associated bottom substrates of Elliott Bay—including the MSU—typically range from coarse sands in the shallow nearshore areas (except where riprap occurs or in depositional areas where silty sands may predominate) to mud (silts and clays) in the deeper slopes and canyons extending into the bay from the main Sound (Tetra Tech 1988a; Dexter et al. 1981). Much of the nearshore subtidal habitats immediately adjacent to the site are composed of steeply sloped riprap and bulkheads.

Small-scale intertidal habitats are present in the MSU, but almost solely consist of artificial substrates such as vertical bulkheads, pilings, and riprap. Only two small sandy pocket beaches (RI **Figure 1-2**) have been observed by WESTON at extreme low tides (less than -2 ft MLLW) between the main and western piers. Subtidal habitats are characterized by steeply sloping, soft-bottom substrates reaching depths of greater than 60 meters in the vicinity of the site. Large quantities of wood debris have been incorporated into the substrate in a number of areas, particularly east and northeast of the Upland Unit. Substrates tend to be coarser in the nearshore area immediately west of the site, due to spillage of sand and gravel near the barge loading facility.

Because of its location within Elliott Bay and its proximity to the Duwamish River, aquatic habitats specifically associated with the MSU may potentially be used by a broad range of species, including migratory salmonids, estuarine and marine fish, marine mammals, and aquatic birds. Invertebrate species also occur in Elliott Bay, although the loss of viable benthic habitats has diminished their abundance and diversity from previous levels (Melvin 1991; Nosho 1991; WDOH 1991).

2.1.3 Receptors

2.1.3.1 Humans

People who are most likely to come in contact with contaminated media in the MSU are tribal fishers and recreational fishers, including those that harvest crab or shrimp. Other recreational users of the bay, such as boaters or parasailors may occasionally occur at the site, but are unlikely to come in contact with contaminated media.

2.1.3.2 Birds

Shorelines of and waters overlying the MSU may provide habitat to a number of water-dependent birds (**Table 2-1**). The majority of these waterfowl potentially utilize habitats in the vicinity of the MSU during their respective overwintering periods. These overwintering waterfowl species are generally found in the central Puget Sound region from early November through late April, with highest concentrations occurring from December through February. The remaining waterfowl associated with the MSU are present on a year-round basis.

General prey assemblages for these birds are provided in **Table 2-1** and include a wide variety of small fishes, crustaceans (e.g., amphipods, crab), molluscs (clams, mussels, snails), and polychaete worms. Most of the year-round and overwintering species are classified as "divers" and actively pursue pelagic and benthic organisms up to 10 meters or more below the water surface.

2.1.3.3 Fishes

Habitats within the MSU may provide spawning and adult forage areas on either a seasonal or year-round basis for numerous estuarine and marine species of fish that are found in Elliott Bay. In addition, juvenile salmonids may use this area for physiological transition to marine waters.

2.1.3.3.1 Estuarine and Marine Fishes

In Elliott Bay, estuarine fishes including Pacific herring (*Clupea harengus*), shiner perch (*Cymatogaster aggregata*), snake prickleback (*Lumpenus sagitta*), Pacific tomcod (*Microgadus proximus*), pile perch (*Rhacochilus vacca*), Pacific sand lance (*Ammodytes hexapterus*), copper rockfish (*Sebastes caurinus*), Pacific staghorn sculpin (*Leptocottus armatus*), and various flatfish species, most notably English sole (*Pleuronectes vetulus*) are common according to historical reports (Tetra Tech 1988a; Dexter et al. 1981). Pacific herring are reported to congregate near the mouth of the Duwamish River and may spawn in intertidal habitats near PSR (Bargman 1991).

Other species commonly found in Elliott Bay that may frequent habitats within the MSU include northern anchovy (*Engraulis mordax*), arrow goby (*Clevelandia ios*), tube-snout (*Aulorhynchus flavidus*), three spine stickleback (*Gasterosteus aculeatus*), surf smelt (*Hypomesus pretiosus*) (Tetra Tech 1988a; Dexter et al. 1981). With the exception of anchovy, these species are likely to spawn at the mouth of the Duwamish River or in other shallow habitats. Several different species of rockfish including brown (*Sebastes auriculatus*), quillback (*S. maliger*), copper, yellowtail (*S. flavidus*), yelloweye (*S. ruberimmus*), and black rockfish (*S. melanops*) also occur in Elliott Bay (Hueckel et al. 1989; Dexter et al. 1981). These species are abundant near the downtown Seattle waterfront as well as south of Alki Point (Hueckel et al. 1989). Striped sea perch (*Embiotoca lateralis*) are also common near the Seattle waterfront, and occur near the mouth of the Duwamish River (Hueckel et al. 1989; Dexter et al. 1981).

Several other species are less common or use Elliott Bay on a seasonal basis. Flatfish that seasonally use deeper portions of the bay include Dover (*Microstomus pacificus*), rex (*Errex zachirus*), slender (*Eopsetta exilis*), sand (*Psettichthys melanostictus*), and C-O sole (*Pleuronichthys coenosus*); Pacific sanddab (*Citharichthys sordidus*); and starry flounder (*Platichthys stellatus*) (Bargman 1991; Tetra Tech 1988a; Dexter et al. 1981). In addition to tomcod, other gadids reported to occur in the bay environment include Pacific cod (*Gadus macrocephalus*), Pacific hake (*Merluccius productus*), and walleye pollock (*Theragra chalcogramma*). Of the four, Pacific cod is least abundant (Dexter et al. 1981). Several hexagrammids, including lingcod (*Ophiodon elongatus*), painted greenling (*Oxylebius pictus*), and whitespotted greenling (*Hexagrammos stelleri*) are also found in the bay, although these species are less common than the flatfishes.

Site-specific data regarding fish and macroinvertebrate occurrences in the MSU were collected as part of a reconnaissance survey in September 1996. In total, 31 species of fish were captured in trawls from waters extending from 30 to 60 meters in depth (**Table 2-2**). The most abundant species collected included English and slender sole (*Eopsetta exilis*), Pacific hake, and Pacific tomcod. Similar species were captured as part of the fish bioaccumulation study and are reported in **Table 4-9** of this report.

2.1.3.3.2 Anadromous Species

Salmonids represent the most important anadromous fish present in the vicinity of the MSU. Chinook (*Onchoryhnchus tshawytscha*), pink (*O. gorbuscha*), and chum (*O. keta*) salmon are common, while coho (*O. kisutch*) and sockeye (*O. nerka*) salmon, steelhead trout (*O. mykiss*), and cutthroat trout (*O. clarki*) are less abundant. Chinook, chum, and coho salmon, and steelhead trout utilize Elliott Bay to access upstream freshwater spawning habitats associated with the Duwamish and Green rivers. Chinook and chum salmon use Elliott Bay and the Duwamish estuary more extensively than other anadromous species (Weitkamp and Schadt 1982; Meyer et al. 1981). Returning adult salmon congregate at the mouth of the Duwamish River in the vicinity of the MSU prior to upstream migrations.

Multiple migratory runs of both native and hatchery-reared salmonid stocks occur seasonally in Elliott Bay and the Duwamish River (Warner and Fritz 1995). Summer and fall chinook, coho, chum, and sockeye salmon, summer and fall steelhead, and cutthroat trout runs occur between late June and early December. Runs of spring chinook and winter steelhead occur between January and late May (Monaco et al. 1990).

Following their emergence from spawning gravels and downstream migration, juvenile salmon use this same estuarine zone to acclimate to saline water conditions. Additionally, these habitats provide feeding areas essential for juvenile chinook and chum salmon (Warner and Fritz 1995; Williams et al. 1975). The residence time of juvenile chinook in the lower Duwamish estuary can last up to 16 or more weeks with peak densities occurring in late May (Simenstad et al. 1982). The highest juvenile chinook densities have been found to occur in the West Waterway of the Duwamish estuary, approximately 1.0 km east of the MSU (Weitkamp and Schadt 1982). Juvenile chum salmon are present in the lower Duwamish estuary and Elliott Bay from early April to late June, with peak abundances reported in mid-April and mid-May. Juvenile chum salmon were observed in high abundance in Elliott Bay at a nearshore shallow water sampling station situated approximately 0.5 km west of the PSR MSU (Weitkamp and Schadt 1982).

Juvenile salmon are believed to be attracted to shade from bulkheads and pier structures and appear to circumscribe the shoreline of Elliott Bay while outmigrating to open waters of central Puget Sound (Meyer et al. 1981). Juvenile pink salmon are common in Elliott Bay during late April to mid-May. Juvenile pink salmon were also observed in high abundance at the same nearshore shallow water sampling station near PSR (Weitkamp and Schadt 1982).

Although juvenile coho are reported to have less dependence on the estuarine habitats for rearing than other salmonids (Healey 1982), the lower Duwamish estuary and Elliott Bay are considered important coho rearing areas as well (Williams et al. 1975).

Longfin smelt (*Spirinchus thaleichthys*) is the only other significant anadromous species in the vicinity of the MSU. Adult smelt migrate into Elliott Bay to spawn over coarse intertidal substrate between November and March (Monaco et al. 1990). Longfin smelt have been observed migrating along the west shore of Elliott Bay and congregating near the mouth the Duwamish River (Dexter et al. 1981).

2.1.3.4 Marine Invertebrates

At the PSR site, most of the available intertidal habitat is characterized by pilings supporting piers, bulkheads, and steeply sloped riprap situated along the shoreline of the site. Assemblages of both attached and free-living estuarine/marine organisms are associated with the vertical surfaces of these man-made structures. Common inhabitants of piling surfaces include barnacles, sea anemones, sponges, tunicates, and mussels (Parametrix 1994).

The remnant intertidal sediment habitat remaining at the site (e.g., at the base of the riprap banks between piers) is composed of sand and mud. The invertebrate communities residing in these areas have not been characterized; however, in the absence of contaminants, these communities would be anticipated to be like to those found in similar habitats along the Duwamish Head and other areas of Elliott Bay.

Much of the nearshore subtidal habitat of the MSU consists of steeply-sloped riprap and bulkheaded areas. These areas provide habitat for marine invertebrates such as barnacles, tube-dwelling worms, and mussels that prefer hard substrate. Some algae, such as *Fucus distichus*, *Enteromorpha intestinalis*, and *Ulva lactuca* are also found colonizing in these areas. These aquatic macrophytes contribute to the structure and complexity of the biological community by providing habitat and food resources for other organisms.

The offshore subtidal habitat within the MSU consists of soft sand or mud substrates. These areas are generally inhabited by assemblages of benthic infauna, with species composition and densities largely representative of the general central Puget Sound and Elliott Bay vicinity. Also, several molluscan species have been reported to reside year-round in Elliott Bay. Species reportedly most abundant are Pacific littleneck (*Protothaca staminea*), butter (*Saxidomus giganteus*), geoduck (*Panope generosa*), bent-nosed (*Macoma nasuta*), heart cockle (*Clinocardium nuttallii*), gaper (*Tresus capax*) and soft-shell clam (*Mya arenaria*) (Scholz 1991;

Schink et al. 1983; Dexter et al. 1981). Manila clams (*Venerupis japonica*) may also be present but in significantly lower numbers (Scholz 1991). Blue mussel (*Mytilis edulis*) are ubiquitous, especially along rocky and urban shorelines (Scholz 1991). The most common species reportedly found in Elliott Bay is the bent-nosed clam (Dexter et al. 1981).

Sampling conducted within the MSU in September 1996 as part of the PSR RI confirmed the presence of *Macoma*, although the most abundant organisms within this genus were identified as *M. carlottensis*. Heart cockle, soft-shell clam, and blue mussel were only infrequently encountered. Geoduck and gaper clam were not observed, but these two bivalves would not typically be collected given the sampling gear used (i.e., in a van Veen grab sampler).

Dungeness (*Cancer magister*) and red rock (*C. productus*) crab are generally found throughout Elliott Bay, but are less abundant than in other estuaries of Puget Sound (Wood 1991). Both species tend to congregate near intertidal and subtidal flats (Johnston 1991). Nearshore habitats of the Duwamish River estuary may have concentrations of Dungeness crab (Wood 1991; WDNR 1977); however, only red rock crab were encountered during the September 1996 reconnaissance survey.

Lastly, three species of shrimp; spot (*Pandalus platyceros*), crangon shrimp (*Paracarangon echinata*), and dock (*Pandalus danae*) shrimp, regularly drift into Elliott Bay from Puget Sound. Spot shrimp are reported to be the most abundant species in Elliott Bay, but do not occur in sufficient numbers to support a commercial fishery. However, commercial fishing for shrimp is allowed seasonally along with tribal harvest. There is also an active recreational fishery for shrimp in some areas of Elliott Bay, including the barge moorage area at the perimeter of the MSU. Crangon shrimp are found throughout the Puget Sound main basin, and significant abundances have been observed in Elliott Bay. Dock shrimp are less common in the bay (Dexter et al. 1981).

Several bottom trawls were conducted in waters of the MSU in September 1996 as part of the PSR RI. A total of 15 different invertebrate species were collected during the reconnaissance survey and the bioaccumulation study in waters extending from 30 to 60 meters in depth (**Table 2-3**). The presence and observed abundance of shrimp caught during the RI investigations differed somewhat from the reported species composition for this area in that Alaskan pink shrimp (*Pandalus eous*) was also captured using the trawl sampling gear.

2.1.3.5 Marine Mammals

Harbor seal (*Phoca vitulina*), California sea lion (*Zalophus californianus*),and harbor porpoise (*Phocoena phocoena*) are known to frequently forage in Elliott Bay (Calambokidas 1991). Populations of these species are stable and as of late may be increasing. Harbor porpoise and harbor seals are year-round residents. Sea lions may utilize water of the MSU in the winter to feed on migrating salmon and steelhead trout (Pfeifer 1991). WESTON field personnel observed both harbor seal and California seal lions hauled out on floats and navigation buoys moored within the MSU during the September 1996 field effort.

2.1.4 Receptors of Special Status

Several species present within close proximity of the PSR Upland and MSU have been classified by the federal government and the State of Washington as species of special concern. These species are provided in **Table 2-4** and discussed below.

2.1.4.1 State Recognized Sensitive Species

Several terrestrial and aquatic species that occur in the vicinity of the PSR site are classified by the Washington Department of Fish and Wildlife as species of special concern (**Table 2-4**). These species require protective measures for their perpetuation due to their population status, sensitivity to habitat alteration, and/or recreational, commercial, or tribal importance. Species of special concern include all state Endangered, Threatened, Sensitive, and Candidate species; animal aggregations considered vulnerable; and those species of recreational, commercial, or tribal importance that are also vulnerable.

Two state monitor species have been identified as breeding within close proximity to PSR and the MSU. These species include osprey (*Pandion haliaetus*) and great blue heron (*Ardea herodias*). In 1996, the Washington Department of Fish and Wildlife identified one osprey nest approximately 2 miles south of the PSR site on the western shore of the Duwamish River. Since the 1940s, the Washington Department of Fish and Wildlife has monitored a great blue heron nesting colony approximately 2 miles south of the PSR site. In 1993, 23 active nests were recorded (Adkins 1997). Both species are expected to feed on aquatic organisms (primarily fish) associated within the MSU. Although osprey may fish in the waters overlying the MSU, heron have few feeding sites due to the lack of intertidal areas or low structures over the water.

In 1994, a bald eagle (*Haliaeetus leucocephalus*) nest was identified approximately 0.25 mile west of PSR (Adkins 1997) on the hillside above Harbor Avenue SW. WESTON field personnel observed the nesting platform during September 1996. During this same period, eagles were repeatedly observed flying over and perching on structures (i.e., moored barges) located within the MSU. Eagles may feed directly on fish or on fish-eating birds occurring in the MSU, depending on the seasonal availability and abundance of different prey. Overall, the MSU may represent only a small portion of the total feeding range used by eagles. The bald eagle is listed as a threatened species by the State of Washington.

Three state monitor species—western grebe (*Aechmophorus occidentalis*), horned grebe (*Podiceps auritus*), and red-necked grebe (*Podiceps grisegena*)—are considered likely to forage in areas of the MSU during the winter. Two state candidate species, common loon (*Gavia immer*) and Brandt's cormorant (*Phalacrocorax penicillatus*), are likely to utilize surface waters associated with the MSU. Common loon are present during the winter months, while Brandt's cormorant is a year-round resident. All three species actively select fish as prey.

The harbor seal and California sea lion are known to forage within Elliott Bay (Calambokidas 1991). Both the harbor seal and the California sea lion are state monitor species. Both species are carnivores and aggressively pursue fish as prey. Sea lions may also prey on seals.

2.1.4.2 Federally Recognized Sensitive Species

Several terrestrial and aquatic species present near the PSR site are classified by the federal government as threatened or endangered species to the list pursuant to 50 CFR 17.11 and 17.12 (**Table 2-4**). An endangered species is recognized as a species in danger of extinction throughout all or a significant portion of its range, while a threatened species is qualified as a species which is likely to become endangered within the foreseeable future.

A population of peregrine falcon (*Falco peregrinus*) is present in downtown Seattle within 2 miles of the PSR site. A nesting pair has been documented in buildings near the eastern shoreline of the Seattle waterfront (Adkins 1997). The peregrine falcon is listed as Endangered by the federal government and is also listed as a state endangered species by the State of Washington. Peregrine feed exclusively on other birds, including shorebirds.

The bald eagle is listed as Threatened by the federal government. Puget Sound Chinook salmon have recently been proposed for Threatened status.

2.2 CONCEPTUAL SITE MODEL

A conceptual site model for the MSU was developed to show potential transport of site-related contaminants to human and ecological receptors that may occur in the vicinity of the site. Created on the basis of historical data and information from both the upland and MSU RI sampling effort results, the model as depicted in RI **Figure 3-5**, is divided into five primary segments—contaminant source, contaminant release and transport mechanisms, potentially impacted media, exposure pathways, and receptors. Additional detail that graphically links the MSU with the PSR Upland Unit is presented in RI **Figure 3-6**.

As shown in the diagrams, sediment represents the primary impacted environmental medium in the MSU under current conditions. Because of completed cleanup actions at the upland facility, potential site-related sources of contaminants and associated pathways (e.g., surfacewater runoff) are expected to be controlled and to no longer contribute to contamination in the MSU. However, sediment tends to retain contaminants and can continue to act as a source of contaminant exposure for various receptors under current or future conditions. Receptors that may come into contact with sediment include benthic organisms (including sedentary shellfish such as clams), other free-living shellfish (such as crab and shrimp), fish, birds, and people fishing or crabbing in the nearshore areas. Contact with contaminated media can also potentially occur via incidental ingestion and dermal contact with sediment and overlying water, and respiration by aquatic organisms. Ingestion of contaminated prey (in the case of aquatic receptors) or seafood (by people) can also result in exposure to contaminants. The relative amounts of exposure from these pathways will differ depending on both the habits of the receptor and the concentration of contaminants in each medium.

In the conceptual site model some pathways have been identified as either major exposure pathways (those expected to contribute most significantly to risks) or as comparatively minor or incomplete pathways (those not expected to contribute significantly to risk). Major pathways were carried forward in the risk assessment process, whereas incomplete or minor pathways were not. Historical pathways (e.g., surface water) were also not evaluated. Specific receptors and pathways were selected for quantitative risk evaluations from among those representing current and future site exposures, as discussed in the following section.

2.3 RISK ASSESSMENT FOCUS

The PSR MSU potentially supports a wide variety of human activities and natural resource uses. It is impractical to assess the risk to all species or people that may be exposed to site-related contaminated media. In order to best support cleanup decisions, specific effects on a limited number of living resources or human populations that occur at the site were selected for evaluation in the risk assessment.

The criteria used to select specific human and ecological receptors included:

- Representation of exposure to site-related contaminated media.
- Sensitivity to contaminants.
- Ecological or socioeconomic importance.

For human receptors, the degree to which a particular subgroup could reflect a reasonable maximum exposure was also considered The type of effects that were evaluated in the risk assessment were primarily selected based on the relevancy to the health of an individual or a population.

A description and rationale for the specific human subpopulations and ecological receptors and effects that were chosen for this risk assessment are provided below.

2.3.1 Human Health Evaluation

Tribal fishers who consume fish and shellfish from the site were selected for evaluation in the human health risk evaluation. Tribal fishers represent subsistence consumers and are considered a sensitive subpopulation because of their typically greater use of seafood in their diet. EPA currently has no information on the use of the PSR site by other subsistence fishers or on their fish consumption rates. In the absence of site-specific subsistence fisher data, a tribal fisher consuming above average amounts of seafood (based on a recent tribal seafood consumption study by Toy et al. [1996]) was selected. In addition, both the Muckleshoot and Suquamish tribes exercise their treaty fishing rights in the vicinity of the PSR site.

2.3.1.1 Human Health Effects Endpoints

Both cancer risks and noncancer impacts were evaluated for tribal fishers who potentially eat fish and shellfish from the PSR site. Cancer risks and noncancer impacts were evaluated using a consistent set of EPA-promulgated toxicity criteria. These evaluations are described briefly in the following paragraphs.

A cancer risk is expressed as a likelihood of a person developing cancer due to exposure only to site-specific contaminants, over a lifetime. This cancer risk is in addition to risks of developing cancer from other activities and exposures (e.g., cigarette smoking or occupational exposures). It is calculated based on measured site contaminant concentrations, specific individual human exposure factors, and a toxicity factor, referred to as the cancer slope (or potency) factor. The cancer slope factor expresses a dose-response relationship and is defined as "a plausible upper-bound estimate of the probability of a response per unit intake of a chemical over a lifetime (EPA 1989a)." Cancer risks of less than one in a million (expressed as 1E-06) usually do not trigger cleanup actions, while risks greater than one in ten thousand (1E-04) (or in the case of Washington State's Model Toxic Control Act [MTCA], one in a hundred thousand [E-05]) are likely to result in consideration of cleanup options. The range of risks between these values (from 1E-06 to 1E-04) is referred to as the risk management range that can form the basic goal for remedial actions at a site. All cancer risks are evaluated with respect to the uncertainties inherent in the parameters used to derive them.

The potential for noncancer impacts is expressed as a hazard quotient. A hazard quotient is a ratio between a site-specific dose and a reference dose. The site-specific dose is calculated based on measured site contaminant concentrations and specific individual human exposure factors. The reference dose represents a dose of a given contaminant below which no adverse noncancer health effects are expected to occur. Hazard quotients of less than 1.0 indicate site exposures that are below the reference dose are unlikely to need cleanup actions. Hazard quotients of greater than 1.0 indicate a potential for adverse noncancer health impacts. As the magnitude of the hazard quotient increases, the potential for adverse effects increases; however, the predicted severity of effects cannot be evaluated based solely on the hazard quotient. Hazard quotients for multiple contaminants, particularly those associated with similar effects and similar modes of action are often summed to develop a hazard index. The hazard index is evaluated on the same scale as the hazard quotient, with values below 1.0 being indicative of no expected effects and values above 1.0 suggesting a potential for adverse impacts to occur.

2.3.2 Ecological Evaluation

Benthic invertebrates (including clams, amphipods, and sand dollars) and bottom fish (specifically English sole) were selected for the ecological risk evaluation. These species were considered representative of site exposures and have demonstrated sensitivities to a wide range of

2.3.2 Ecological Evaluation

Benthic invertebrates (including clams, amphipods, and sand dollars) and bottom fish (specifically English sole) were selected for the ecological risk evaluation. These species were considered representative of site exposures and have demonstrated sensitivities to a wide range of chemicals, including those potentially released from the PSR site. Many benthic invertebrates live in contact with the sediment and are therefore directly exposed to a site-contaminated medium. In addition, they are an important component of all marine food webs, and are prey for many higher trophic order species. Although bottom fish are not considered economically important, contaminant uptake is directly linked to either contact with the sediment or ingestion of benthic invertebrates and thus are representative of exposure to contaminated media at the site.

Marine birds including auklets, cormorants, and mergansers, and marine mammals, including harbor seals, and California sea lions have been documented within Elliott Bay (see **Section 2.1.3**—Receptors). Although ingestion of contaminated prey represents a major exposure pathway for marine birds, it is likely that prey from the site only represent a small fraction of their diet. Because of their migratory behavior and extensive ranges, these birds and mammals are expected to spend little time within the area bounded by the MSU. Therefore, effects to these marine birds, based on their limited degree of exposure, do not represent appropriate endpoints for an evaluation of risks associated with the MSU.

2.3.2.1 Ecological Effects Endpoints

Evaluation of the health of benthic invertebrate communities was conducted based on multiple effects measures commonly used to assess impacts in the Puget Sound region:

- Mortality of adult amphipods (*Ampelisca abdita,* a crustacean) as measured in a laboratory sediment bioassay.
- Abnormal development and mortality of sand dollar embryos (*Dendraster excentricus,* an echinoderm) as measured in a laboratory sediment bioassay.
- Alteration in benthic community structure relative to background conditions (including abundance and diversity), based on field-collected samples.
- Mortality and reduced growth in clams (*Macoma nasuta*) exposed to site sediments in a laboratory bioassay.
- Accumulation of selected contaminants in clam tissues above background levels in Elliott Bay.

The health of bottom fish populations was evaluated based on two effects endpoints. The accumulation of selected contaminants in the bodies of English sole (*Pleuronectes vetulus*) from the site was compared to the data on chemical body burdens reported in the literature to cause mortality, reduced growth, or other deleterious effects in various fish species. In addition, a simple model was used to estimate the transfer of bioaccumulative contaminants from a fish to its eggs with subsequent comparison to egg effects data from the literature representing egg lethality or abnormal development (see **Attachment K.2** for life histories for these species).

These benthic invertebrate and fish effects data were used to calculate hazard quotients or cumulative hazard indices to represent risks to various ecological receptors at the site.

Table 2-1—Avian Species Expected to Inhabit the Marine Sediments Unit

Common Name	Scientific Name	Seasonality [a]	Primary Winter Food
Common loon	*Gavia immer*	W	fish
Yellow-billed loon	*Gavia adamsii*	W	fish
Pacific loon	*Gavia pacifica*	W	fish
Red-throated loon	*Gavia stellata*	W	fish
Western grebe	*Aechmophorus occidentalis*	W	fish, aquatic insects
Red-necked grebe	*Podiceps grisegena*	W	aquatic insects, invertebrates, fish
Horned grebe	*Podiceps auritus*	W	fish, crustaceans
Eared grebe	*Podiceps nigricollis*	W	aquatic insects, larvae, fish
Pied-billed grebe	*Podilymbus podiceps*	Y	aquatic insects, invertebrates
Double-crested cormorant	*Phalacrocorax auritus*	Y	fish
Brandt's cormorant	*Phalacrocorax penicillatus*	Y	fish
Pelagic cormorant	*Phalacrocorax pelagicus*	W	fish
Great blue heron	*Ardea herodias*	Y	fish, amphibians, etc.
Greater scaup	*Aythya marila*	W	molluscs, etc.
Lesser scaup	*Aythya affinis*	W	molluscs. amphibians, etc.
Black scoter	*Melanitta nigra*	W	molluscs, crustaceans
White-winged scoter	*Melanitta fusca*	W	molluscs, crustaceans, aq. insects
Surf scoter	*Melanitta perspicillata*	W	molluscs, crustaceans
Common goldeneye	*Bucephala clangula*	W	crustaceans, molluscs
Bufflehead	*Bucephala albeola*	W	fish, aquatic insects, vegetation
Common merganser	*Mergus merganser*	W	fish
Red-breasted merganser	*Mergus serrator*	W	fish
Hooded merganser	*Lophodytes cucullatus*	Y	fish
American coot	*Fulica americana*	Y	aquatic vegetation, algae, etc.
Herring gull	*Larus argentatus*	W	scavenges, omnivore
Glaucous-winged gull	*Larus glaucescens*	Y	molluscs, fish, scavenges
California gull	*Larus californicus*	W	invertebrates, fish, scavenges
Western gull	*Larus occidentalis*	Y	aquatic invertebrates
Bonaparte's gull	*Larus philadelphia*	W	fish, insects, scavenges
Ring-billed gull	*Larus delawarensis*	W	fish, insects, scavenges
Mew gull	*Larus canus*	W	fish, insects, scavenges
Pigeon guillemot	*Cepphus columba*	Y	crustaceans, molluscs
Rhinoceros auklet	*Cerorhinca monocerata*	W	crustaceans, fish
Bald eagle	*Haliaeetus leucocephalus*	Y	fish, sm. mammals, seabirds, carrion
Belted kingfisher	*Ceryle alcyon*	Y	fish
American crow	*Corvus brachyrhynchos*	Y	omnivore

[a] Period during which species is expected to be found at the PSR site: W=winter, Y=year-round.

Table 2-2—PSR Phase 2 Reconnaissance Trawl Results

Common Name	Scientific Name	Otter Trawl PSR-OT1-RC 9/10/96 30 m	Otter Trawl PSR-OT2-RC 9/10/96 40 m	Otter Trawl PSR-OT3-RC 9/10/96 40 m	Otter Trawl PSR-OT4-RC 9/10/96 57 m	Beam Trawl PSR-BT4-RC 9/11/96 57 m	Beam Trawl PSR-BT1-RC 9/11/96 30 m (failed tow)	Beam Trawl PSR-BT2-RC 9/11/96 40 m (creosote in net)	Total Capture by Species	% of Capture Overall
Finfish Species										
Pacific sanddab	*Citharichthys sordidus*		1	4	11				16	4.26%
Speckled sanddab	*Citharichthys stigmaeus*	3	1		1				5	1.33%
Pacific herring	*Clupea harengus pallasi*				2				2	0.53%
Roughback sculpin	*Chitonotus pugetensis*	1	1	3				2	7	1.86%
Shiner perch	*Cymatogaster aggregata*			1	6				7	1.86%
Striped sea perch	*Embiotoca lateralis*	1							1	0.27%
Rex sole	*Errex zachirus*			1	3				4	1.06%
Slender sole	*Eopsetta exilis*		2	13	20	4		3	42	11.17%
Whitespotted greenling	*Hexagrammos stelleri*	1		1					2	0.53%
Flathead sole	*Hippoglossoides elassodon*			2	6				8	2.13%
Pacific staghorn sculpin	*Leptocottus armatus*							1	1	0.27%
Blackbelly eelpout	*Lycodopsis pacificus*				3				3	0.80%
Pacific hake	*Merluccius productus*				35	1			36	9.57%
Pacific tomcod	*Microgadus proximus*		5	3	17				25	6.65%
Dover sole	*Microstomus pacificus*			2*	6				6	1.60%
Pygmy poacher	*Odontopyxis trispinosa*	1	2	2				1	6	1.60%
Bluebarred prickleback	*Plectobranchus evides*							1	1	0.27%
Rock sole	*Pleuronectes bilineatus*	6		15	1				22	5.85%
English sole	*Pleuronectes vetulus*	9	29	34	48	2		4	126	33.51%
Plainfin midshipman	*Porichthys notatus*		1	2	9	5		2	19	5.05%
Sand sole	*Psettichthys melanostictus*			13	1				14	3.72%
Brown rockfish	*Sebastes auriculatus*				1				1	0.27%
Copper rockfish	*Sebastes caurinus*			2	2				4	1.06%
Slim sculpin	*Radulinus asprellus*	3				1		8	12	3.19%
Pile perch	*Rhacochilus vacca*	3			1				4	1.06%
Northern ronquil	*Ronquilus jordani*			1				1	2	0.53%
	Total Fish Catch	28	42	97	173	13	0	23	376	100%
Invertebrate Species										
Crangon shrimp	*Crangon spp.*							2	2	3.57%
Sea star	*Evasterias troschelii*					6		6	12	21.43%
Sea star	*Luidia foliolata*					1		6	7	12.50%
Vermillion star	*Mediaster aequalis*							3	3	5.36%
Spot shrimp	*Pandalus platyceros*				8	1			9	16.07%
Benthic squid	*Roscia spp.*			1				3	4	7.14%
Sun star	*Solaster dawsoni*		3		1			12	16	28.57%
Sea cucumber	*Stichopus californicus*			1					3	5.36%
	Total Invertebrate Catch	0	3	2	9	8	0	32	56	100%

* C * One individual with tumor.

Table 2-3—Invertebrate Species Collected in the Marine Sediments Unit

Common Name	*Scientific Name*
Sea star	*Hippasteria spinosa*
Sea star	*Luidia foliolata*
Sea star	*Evasteria troschelii*
Blood star	*Henricia leviuscula*
Sun star	*Solaster dawsoni*
Vermillion star	*Mediaster aequalis*
Sea cucumber	*Stichopus californicus*
Sea cucumber	*Cucumaria piperata*
Alaskan pink shrimp	*Pandalus eous*
Spot shrimp	*Pandalus platyceros*
Crangon shrimp	*Crangon spp.*
Octopus	*Octopus rubescens*
Benthic squid	*Roscia spp.*
Snail	*Ceratostoma foliatum*
Nudibranch	*Armina californica*

Table 2-4—Species of Special Concern—State and Federal Status

Common Name	Scientific Name	State Status	Federal Status
Fish			
Puget Sound Chinook salmon	*Onchorhynchus tshawytscha*	--	FT (proposed)
Birds			
Common loon	*Gavia immer*	SC	--
Western grebe	*Aechmophorus clarkii*	SM	--
Horned grebe	*Podiceps auritus*	SM	--
Red-necked grebe	*Podiceps grisegena*	SM	--
Great blue heron	*Ardea herodias*	SM	--
Bald eagle	*Haliaeetus leucocephalis*	ST	FT
Osprey	*Pandion haliaetus*	SM	--
Brandt's cormorant	*Phalacrocorax penicillatus*	SC	--
Peregrine falcon	*Falco peregrinus*	SE	FE
Marine Mammals			
Harbor seal	*Phoca vitulina*	SM	--
California sea lion	*Zalophus californianus*	SM	--

-- = Not listed

SE = State Endangered—Wildlife species native to the State of Washington that are seriously threatened with extinction throughout all or a significant part of their ranges within the state. Endangered species are legally designated in WAC 232-12-014.

ST = State Threatened—Wildlife species native to the State of Washington that are likely to become endangered within the foreseeable future throughout significant portions of their ranges within the state without cooperative management or removal of threats. Threatened species are legally designated in WAC 232-12-011.

SC = State Candidate—Wildlife species that are under review by the Department for possible listing as endangered, threatened, or sensitive. A species will be considered for State Candidate designation if sufficient evidence suggests that its status may meet criteria defined for endangered, threatened, or sensitive species in WAC 232-12-297.

SM = State Monitor—Wildlife species native to the State of Washington that:

1. were at one time classified as endangered, threatened or sensitive;
2. require habitat that has limited availability during some portion of its life cycle;
3. are indicators of environmental quality;
4. require further field investigation to determine population status;
5. have unresolved taxonomy which may bear upon their status classification;
6. may be competing with or impacting other species of concern; or
7. have significant popular appeal.

FE = Federally Endangered—A species in danger of extinction throughout all or a significant portion of its range.

FT = Federally Threatened—A species which is likely to become endangered within the foreseeable future.

SECTION 3

CONTAMINANT SELECTION

The human health and ecological risk assessments are based on analytical data collected during the RI. These data are detailed in the Phase 1 and Phase 2 technical memoranda (WESTON 1996a; 1997a) and the RI report (WESTON 1998). Historical data collected as part of previous sediment investigations were not applied to risk assessment calculations because modifications in analytical methods and techniques since historical data were collected resulted in data that were no longer directly comparable. In addition, the distribution of sampling in the RI was designed to encompass historical sampling locations, and therefore the historical data are of limited use for refining the extent of contamination.

The sampling and analysis plan implemented during the RI was developed to focus on those contaminants that were used as part of the wood-treating process at PSR and were expected to contribute the majority of risk. As noted in **Section 4** of the RI Work Plan (WESTON 1996b), chemical analysis was performed for a subset of the contaminants contained in EPA's target compound list (TCL) and target analyte list (TAL). The RI field investigation was divided into three phases. Phase 1 consisted of surface (0 to 10 cm) sediment sampling and analysis; Phase 2 entailed sampling and analysis of surface sediment, shallow and deep subsurface sediment, clam tissue, and fish tissue for contaminants selected based on the results of the Phase 1 sampling event. Phase 3 was conducted to finalize the extent of contamination in surface sediment.

The progressive narrowing of focus to those contaminants potentially of greatest concern was accomplished based on the process depicted in **Figure 3-1**. Criteria for inclusion in the risk assessment were:

- Relationship of contaminants in sediments to site activities at PSR
- Chemical exceedance of Washington State sediment criteria
- Bioaccumulative properties of contaminants in sediments
- Relative extent and distribution of contaminants in sediments
- Exceedance of background concentrations of chemicals in sediments and tissues
- Exceedance of human health risk-based concentrations

Risk-based screening concentrations were not available for ecological receptors; therefore, this final comparison to risk-based criteria was only conducted for the human health evaluation.

Each of the bullets presented above is discussed below in **Sections 3.1** through **3.6**. **Table 3-1** presents the results of the comparisons to criteria and identifies those contaminants of potential concern (COPCs) that were carried forward for evaluation in the risk assessments.

3.1 DETERMINATION OF SITE-RELATEDNESS

A contaminant was analyzed for only if it was determined to be site-related, as identified through review of historical data. The screening process used to select contaminants for analysis is described in detail in the RI Work Plan (WESTON 1996b). Based on review of historical data, the following contaminants were determined to potentially be site-related and were analyzed in sediment collected during Phase 1:

Potentially Site-Related Contaminants

Organic Contaminants	Inorganic Contaminants
PCBs	Arsenic
Phenolic Compounds	Chromium
Dibenzofuran	Copper
Dioxins/furans	Mercury
PAHs	Zinc

Subsequent analysis of the spatial distribution and magnitude of these chemicals suggested that mercury and PCBs had not been released from the PSR facility; rather, they appeared to be related to other sources. Specifically, mercury was detected at concentrations above its CSL criterion (0.59 mg/kg), primarily in the eastern-most portion of the MSU. Concentrations in the northern and western portion of the MSU were lower (below the CSL or SQS criterion [0.41 mg/kg]). Further, east to west attenuation of mercury suggested the potential source of mercury may exist to the east of the MSU.

The distribution of total PCBs (represented by the sum of all detected Aroclors) in sediment were highest in the western portion of the MSU, particularly in the vicinity of the Longfellow Creek overflow channel outfall. Given the historical landfilling and transformer storage activities that occurred at the old Seattle Landfill upstream from the PSR site, it is likely that sources other than PSR contributed to the release of PCBs to the MSU.

Accordingly, PCBs and mercury were dropped as COPCs for the MSU risk evaluation.

3.2 COMPARISON OF SEDIMENT CONCENTRATIONS TO SEDIMENT CRITERIA

Contaminant concentrations measured in surface sediment samples were compared to Washington State Sediment Management Standards (SMS) Sediment Quality Standards (SQS) and Cleanup Screening Level (CSL) chemical concentrations. The SQS and CSL criteria are ecological effects-based concentrations that were used to screen contaminants for both the human health and ecological risk assessments because they tend to be more conservative than human health risk-based screening concentrations for all contaminants except those that bioaccumulate.

The SMS SQS chemical criteria represent concentrations above which significant deleterious biological effects are predicted for more sensitive species; CSL chemical criteria represent concentrations above which moderate to severe biological effects may occur (depending on the magnitude of contamination), and are generally used to identify areas potentially requiring active remediation. The SMS criteria are based on the apparent effects threshold (AET) approach that incorporated data from matched sediment chemistry and biological effects measures collected within Puget Sound (PTI 1988).

For comparisons to the state standards, all nonionic/nonpolar organic chemicals must be normalized to percent total organic carbon (TOC) content. However, the SMS TOC-normalized criteria are generally only effective at predicting contaminant bioavailability in sediments with TOC content greater than 0.5 percent. Also, in cases where high TOC (greater than 3 to 4 percent) may be due to some anthropogenic contribution (e.g., oils, organic sludges, or wood debris), TOC normalization may not be predictive. Because wood debris and petroleum products were observed in some sediment samples from the MSU, TOC content was reviewed on a sample-by-sample basis to determine the appropriateness of normalizing the organic data. The results of this review suggested that samples with TOC content greater than 4 percent were potentially anthropogenically enriched. Therefore, concentrations of nonionic/nonpolar organic chemicals for these samples (as well as those with TOC content less than 0.5 percent) were compared with AET criteria, which are the functional equivalent of the SQS and CSL chemical criteria, only they are expressed on a dry-weight basis. The lowest AET (LAET) was used as the equivalent of the SQS, and the second-lowest AET (2LAET) was used in place of the CSL.

In some cases, comparisons to the SMS and AET criteria required the calculation of group sums (i.e., total low-molecular weight polycyclic aromatic hydrocarbons [LPAHs], total high-molecular weight PAHs [HPAHs], and total benzofluoranthenes). In such cases, sums were calculated based on detected values only, or, if all group constituents were undetected, the maximum detection limit among the individual compounds was selected as representative of the sum of the compounds. Other SMS requirements followed in the calculation of group sums included the following:

- Total LPAHs was represented by the sum of the detected concentrations of acenapthene, acenaphthylene, anthracene, fluorene, naphthalene, and phenanthrene.

- Total HPAHs was represented by the sum of the detected concentrations of benz(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, total benzofluoranthenes (sum of the "b," "j," and "k" isomers), chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, and pyrene.

For sediments, normalization of nonionic/nonpolar chemical results was conducted by dividing the dry-weight concentration of a given chemical by the decimal fraction of TOC measured in the sample.

Contaminants that were undetected, or were measured below SQS and AET sediment criteria in greater than 95 percent of the samples and not considered bioaccumulative were eliminated from consideration as a COPC for the site. Contaminants eliminated based on this comparison were copper and zinc. Arsenic and chromium were not detected in surface sediment samples taken during Phase 1 and were therefore eliminated from further consideration in the risk assessment process (**Table 3-1**).

3.3 IDENTIFICATION OF BIOACCUMULATIVE CONTAMINANTS

Because the SQS and CSL criteria do not address adverse effects associated with the bioaccumulation of contaminants, an additional screening step was performed. In this step, contaminants eliminated in previous steps were re-evaluated to determine their potential for bioaccumulation. If a previously eliminated COPC (which was detected in at least one sample) was determined to be bioaccumulative, it was retained. Based on this evaluation, no site-related chemicals were added to the list of potential COPCs.

3.4 CO-OCCURRENCE OF RELATED CONTAMINANTS

During data analysis, it was noted that some contaminants were only found in the same locations where other, more toxic compounds were also detected. Specifically, it was noted that phenols and dibenzofuran co-occurred with PAHs. Phenolic compounds and dibenzofurans are more soluble and would not be expected to persist with increasing distance from the source or with increasing time from the release/disposal event. Additionally, PAHs are more toxic to human and ecological receptors and were more widespread at higher concentrations within the MSU than phenols and dibenzofuran. Therefore, it was anticipated that any cleanup actions that would address PAHs would also account for adequate cleanup of phenolic compounds and dibenzofurans. Hence, phenolic compounds and dibenzofuran were not retained for further analysis in the risk assessment (**Table 3-1**).

3.5 COMPARISONS WITH BACKGROUND CONCENTRATIONS

The maximum concentrations of contaminants (dioxins/furans and PAHs) measured in sediment, clam tissue and fish tissue from PSR were compared to those measured in sediment, clam tissue and fish tissue in Elliott Bay background samples. The MSU is located in an industrialized harbor (i.e., Elliott Bay) in which both inorganic and organic contaminants have been identified has having ubiquitous distributions (PTI 1991a). Therefore, site-related COPCs were compared to measured background concentrations.

EPA's recommended toxicity equivalents approach for addressing potential risks associated with complex mixtures of chlorinated dioxins and furans was used in the evaluation of the surface sediment and tissue data. The approach is based on the use of toxicity equivalency factors (TEFs), which, when applied, result in the expression of congener-specific concentrations in terms of 2,3,7,8-TCDD equivalents (EPA 1989b). This approach requires multiplying dioxin and furan congener concentrations by their respective TEFs and then summing the congener results to obtain the total 2,3,7,8-TCDD equivalents in each sample. For consistency with the approach to data summing used in the SMS, sums were calculated using detected values only. The TEFs used in the calculations are presented in **Table 3-2**. The 2,3,7,8-TCDD equivalent concentrations were then normalized to sediment TOC content, where appropriate, following the procedures described above for conducting TOC-normalization (see **Section 3.2**).

3.5.1 Sediments

Background concentrations for dioxins and furans (based on 2,3,7,8-tetrachlorodibenzo-p-dioxin [TCDD] equivalents) in sediment were derived by averaging the detected values for these chemicals (measured during Phase 1 and Phase 2 sampling) at each of the four background sampling stations (**Table 3-3**). The MSU chemical data (**Table 3-4**) were then compared to these average background concentrations to determine which of these chemicals, if any, should be carried forward in the risk assessment as bioaccumulative contaminants of concern.

No additional contaminants in sediment were eliminated based on comparison to background concentrations. Therefore, all site-related chemicals (PAHs and dioxins and furans) detected in PSR sediment that did not co-occur with more widely distributed chemicals were carried forward in the ecological risk assessment as COPCs.

3.5.2 Clam Tissue

Following exposure to site sediments, concentrations of contaminants (dioxins and furans and PAHs) in whole body clam tissues (**Table 3-5**) were compared with average contaminant concentrations in clam tissues exposed to sediments from background locations in Elliott Bay. Only two of the four background locations were used in the bioaccumulation study; therefore, background clam tissue concentrations are represented by the mean of stations BK01 and BK04, as sampled during the Phase 2 investigation.

For the purposes of these comparisons, the wet-weight concentrations of the lipophilic compounds (i.e., PAHs and dioxins and furans) in the whole body clam samples were normalized to percent lipid content to minimize the effects of physiological condition and age of individual organisms. Lipid normalization was conducted by dividing the measured wet-weight concentration by the sample-specific decimal fraction of lipid. Because inorganics are not lipophilic, comparisons of inorganic concentrations in the tissue samples were conducted on a wet-weight basis. For consistency with the approach to evaluating the sediment chemical data, concentrations of detected individual LPAHs and HPAHs were summed to represent total LPAH and total HPAH concentrations; and dioxin and furan congener data were converted and summed to obtain 2,3,7,8-TCDD equivalents (see **Section 3.5**). In cases where all individual PAHs or TCDD congeners were not detected, the compound totals were represented by maximum detection limits.

Background concentrations for clam tissues were derived by averaging the detected values of contaminants in the whole body tissues exposed to sediment from BK01 and BK04 during the Phase 2 investigation. If a particular chemical was not detected in any of the background tissue samples, the maximum detection limit was selected as representative of background for that chemical. The background concentrations used in the clam tissue screening process are summarized in **Table 3-6**.

The results of the clam tissue background screening indicated that all chemicals were detected in clams at concentrations exceeding background, with the following exceptions:

- Naphthalene
- Acenaphthylene
- Acenaphthene
- Dibenz(a,h)anthracene
- 2-Methylnaphthalene
- 2-Chloronaphthalene

Therefore, all site-related chemicals (PAHs and dioxins and furans) detected in clam tissues, except those listed above, were carried forward in the ecological risk assessment as COPCs in clam tissues, and through a final risk-based screening step in the human health risk assessment.

3.5.3 Fish Tissue

Chemical data for dioxins and furans in MSU whole body and fillet fish tissues (**Table 3-7a** and **b**) were compared with contaminant concentrations of the same measured in Elliott Bay background fish tissues (**Table 3-8**) for the selection of contaminants to be assessed in fish. For the purposes of this comparison, the wet-weight concentrations of dioxins and furans were normalized to percent lipid content to minimize the effects of physiological condition and age of individual organisms. Lipid normalization was conducted by dividing the measured wet-weight concentration by the sample-specific decimal fraction of lipid.

Background levels for fish tissues were derived by averaging the detected concentrations for contaminants measured in tissues collected from each of the background trawling locations associated with BK01 and BK03. If a particular contaminant was not detected in any of the background tissue samples, the maximum detection limit was applied as the background concentration. Background concentrations for fish tissue are provided in **Table 3-8**.

Lipid content in fish collected in the MSU ranged from 2.1 to 4.0 percent, with an average lipid content of 3.0 percent. Lipid content in background fish ranged from 1.6 to 3.1 percent, with an average of 2.6 percent.

Dioxins and furans were detected in whole body fish tissues samples at concentrations exceeding the background fish tissue value for TCDD at three of the six samples collected; two from the west transect and one from the north transect. Therefore, dioxins and furans measured in fish tissues were carried forward in the ecological risk assessment as COPCs, and through a final risk-based screening step for the human health risk assessment.

3.6 HUMAN HEALTH RISK-BASED SCREENING

The human health risk assessment focuses on those chemicals that pose the greatest potential for concern. As discussed above, only those chemicals that are potentially linked to site activities and that are detected in site media at concentrations greater than those measured in background area media are considered in the human health assessment. In addition to these screening criteria, COPCs for the human health risk assessment were selected based on comparison of site concentrations with human health risk-based screening concentrations, conservative (i.e., protective) values below which a substantial risk is unlikely.

Human health risk-based screening concentrations are presented in **Table 3-9**. These concentrations are based on EPA Region III's Risk-Based Concentration (RBC) Table (EPA 1996c) values for fish tissue. These risk-based concentrations are calculated using target risk levels of 1.0E-06 for cancer risks and a 0.1 hazard quotient for non-cancer effects. The Region III RBCs were adjusted to reflect shellfish as well as finfish consumption, and thus reflect a higher potential total seafood consumption rate. The RBCs were adjusted to be protective of people who eat as much as 205 grams of all (fin)fish and shellfish per day associated with the PSR MSU (based on Toy et al. 1996), rather than the 54 g/day consumption rate considered to be representative of the overall U.S. population (as reported in EPA 1996c). By accounting for consumption of both fish and shellfish in the screening concentrations, the screening process was protective of people who eat large amounts of both fish and shellfish. These screening concentrations are intentionally conservative to ensure that only contaminants certain not to be associated with deleterious human health effects are eliminated from further consideration in the human health risk assessment. The same concentrations were used for screening contaminants in both fish and clam tissue.

Dioxins and furans were the only contaminants included in the fish tissue screening, while PAHs and dioxins and furans were included in the shellfish tissue screening. PAHs were not screened in fish tissue because fish readily metabolize and do not accumulate PAHs. Dioxins and furans were screened as totals (i.e., total 2,3,7,8-TCDD equivalents) of individually measured contaminants. PAHs were screened as individual compounds, with the exception of seven carcinogenic PAHs (benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, and indeno[1,2,3-cd]pyrene), which were screened using total benzo(a)pyrene (B[a]P) equivalents (see **Section 5.1** for details). No contaminants were eliminated from concern in fish tissue; three chemicals (anthracene, fluoranthene, and fluorene) were eliminated from concern in clam tissue. All chemicals that exceeded risk-based concentrations were carried forward in the human health risk assessment as COPCs. Two chemicals (benzo[g,h,i]perylene, and phenanthrene) in clam tissue were retained as COPCs, but did not have numerical toxicity criteria available for further quantitative evaluation in the risk assessment.

SECTION 3 TABLES

Table 3-1—Identification of Contaminants of Potential Concern for the Human Health and Ecological Risk Assessments

Contaminant	Comparison to Screening Criteria									Contaminants of Potential Concern to Human Health[1]		Contaminants of Potential Concern to Ecological Receptors[1]		
	Potentially Site-Related	Detected Above SMS Criteria in Greater than 5% of Sediment Samples	Bioaccumulative	Co-Occurs with Chemicals of Higher Toxicity	Present Above Background in Sediment	Present Above Background in Clam Tissue	Present Above Background in Fish Tissue	Exceeded Human Health RBCs in Clam Tissue	Exceeded Human Health RBCs in Fish Tissue	Shellfish	Fish	Sediment	Clams	Fish
Dioxins/Furans[2]	Y	N/A	Y	N/A	Y	Y	Y	Y	Y	✓	✓	✓	✓	✓
PAHs														
Acenapthylene	Y	N	Y[8]	N/A	Y	N*	N/A	–	N/A			✓		
Acenaphthene	Y	Y	Y[8]	N/A	Y	N*	N/A	–	N/A			✓		
Anthracene	Y	Y	Y[8]	N/A	Y	Y	N/A	N*	N/A			✓	✓	
Benzo(a)anthracene	Y	Y	Y[8]	N/A	Y	Y	N/A	Y	N/A	✓		✓	✓	
Benzo(a)pyrene	Y	Y	Y[8]	N/A	Y	Y	N/A	Y	N/A	✓		✓	✓	
Benzo(b)fluoranthene	Y	Y	Y[8]	N/A	Y	Y	N/A	Y	N/A	✓		✓	✓	
Benzo(g,h,i)perylene	Y	Y	Y[8]	N/A	Y	Y	N/A	N/A[7]	N/A	✓		✓	✓	
Benzo(k)fluoranthene	Y	Y	Y[8]	N/A	Y	Y	N/A	Y	N/A	✓		✓	✓	
2-Chloronapthalene	Y	N	Y[8]	N	Y	N*	N/A	–	N/A			✓		
Chrysene	Y	Y	Y[8]	N/A	Y	Y	N/A	Y	N/A	✓		✓	✓	
Dibenz(a,h)anthracene	Y	Y	Y[8]	N/A	Y	N*	N/A	N[6]	N/A	✓[6]		✓		
Fluoranthene	Y	Y	Y[8]	N/A	Y	Y	N/A	N*	N/A			✓	✓	
Fluorene	Y	Y	Y[8]	N/A	Y	Y	N/A	N*	N/A			✓	✓	
Indeno(1,2,3-cd)pyrene	Y	Y	Y[8]	N/A	Y	Y	N/A	Y	N/A	✓		✓	✓	
2-Methylnaphthalene	Y	Y	Y[8]	N	Y	N*	N/A	–	N/A			✓		
Naphthalene	Y	Y	Y[8]	N/A	Y	N*	N/A	–	N/A			✓		
Phenanthrene	Y	Y	Y[8]	N/A	Y	Y	N/A	N/A[7]	N/A	✓		✓	✓	
Pyrene	Y	Y	Y[8]	N/A	Y	Y	N/A	Y	N/A	✓		✓	✓	
Total benzofluoranthenes[4]	Y	Y	Y[8]	N/A	Y	Y	N/A	N/A	N/A			✓	✓	
Total HPAH[4]	Y	Y	Y[8]	N/A	Y	Y	N/A	N/A	N/A			✓	✓	
Total LPAH[4]	Y	Y	Y[8]	N/A	Y	Y	N/A	N/A	N/A			✓	✓	
Total B(a)P[5]	Y	N/A	Y[8]	N/A	Y	Y	N/A	Y	N/A	✓				

Table 3-1—Identification of Contaminants of Potential Concern for the Human Health and Ecological Risk Assessments

Contaminant	Comparison to Screening Criteria									Contaminants of Potential Concern to Human Health[1]		Contaminants of Potential Concern to Ecological Receptors[1]		
	Potentially Site-Related	Detected Above SMS Criteria in Greater than 5% of Sediment Samples	Bioaccumulative	Co-Occurs with Chemicals of Higher Toxicity	Present Above Background in Sediment	Present Above Background in Clam Tissue	Present Above Background in Fish Tissue	Exceeded Human Health RBCs in Clam Tissue	Exceeded Human Health RBCs in Fish Tissue	Shellfish	Fish	Sediment	Clams	Fish
PCBs (total)[3]	N*	--	--	--	--	--	--	--	--					
Dibenzofuran	Y	Y	N	Y*	--	--	--	--	--					
Phenolic Compounds	Y	Y	N	Y*	--	--	--	--	--					
Inorganics														
Arsenic	Y	N*	--	--	--	--	--	--	--					
Chromium	Y	N*	--	--	--	--	--	--	--					
Copper	Y	N*	--	--	--	--	--	--	--					
Mercury[3]	N*	--	--	--	--	--	--	--	--					
Zinc	Y	N*	--	--	--	--	--	--	--					

N/A = Not applicable: Criteria not applicable to this chemical OR chemical not sampled in this medium.
Y = Yes
N = No
* = Chemical eliminated at this step.
-- = Chemical previously eliminated.
[1] Check marks (✓) indicate that chemical was retained as a contaminant of potential concern for the risk assessment for the given receptor.
[2] As total 2,3,7,8-TCDD equivalents.
[3] PCBs and mercury were not retained for evaluation in the risk assessment because they do not appear to be site-related.
[4] Contaminants included in total compound groups defined in the Phase 2 Technical Memorandum (WESTON 1997).
[5] Total B(a)P equivalents include 7 carcinogenic PAHs (benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, and dibenz(a,h)anthracene).
[6] Contaminant retained in human health risk assessment because it was one of seven carcinogenic PAHs, the total concentration of which, was detected above background and RBCs.
[7] No human health risk-based screening concentration available; retained as COPC for qualitative evaluation in human health risk assessment.
[8] PAHs are metabolized by fish and so were not measured in fish tissue as bioaccumulative contaminants.

Table 3-2—2,3,7,8-TCDD Toxicity Equivalency Factors (TEFs) for Chlorinated Dibenzo-p-Dioxins and Dibenzofurans (EPA 1989b)

Compound	TEF
Dibenzodioxins	
2,3,7,8-TCDD	1.00
1,2,3,7,8-PeCDD	0.50
1,2,3,6,7,8-HxCDD	0.10
1,2,3,7,8,9-HxCDD	0.10
1,2,3,4,7,8-HxCDD	0.10
1,2,3,4,6,7,8-HpCDD	0.01
1,2,3,4,6,7,8,9-OCDD	0.001
Dibenzofurans	
2,3,7,8-TCDF	0.10
1,2,3,7,8-PeCDF	0.05
2,3,4,7,8-PeCDF	0.50
1,2,3,6,7,8-HxCDF	0.10
1,2,3,7,8,9-HxCDF	0.10
1,2,3,4,7,8-HxCDF	0.10
2,3,4,6,7,8-HxCDF	0.10
1,2,3,4,6,7,8-HpCDF	0.01
1,2,3,4,7,8,9-HpCDF	0.01
1,2,3,4,6,7,8,9-OCDF	0.001

T = Tetra
Pe = Penta
Hx = Hexa
Hp = Hepta
O = Octa

Table 3-3—Surface Sediment Background[a] Concentrations of COPCs

Compound	Concentration						
	Phase 1				Phase 2		Average Background
	BK001	BK001D[b]	BK002	BK003	BK001	BK004	
PAHs µg/kg-DW							
Naphthalene	48	30 J	37 U	36 U	26	232	84
Acenaphthylene	19 J	15 J	26 J	36 U	19	37	23
Acenaphthene	226	63	17 J	36 U	44	32	76
Fluorene	222	64	24 J	36 U	53	37	80
Phenanthrene	2,220	635	138	36 U	542	217	750
Anthracene	728	200	81	36 U	164	89	252
Total LPAH	*3,463*	*1,008*	*286*	*36 U*	*847*	*644*	*1,249*
Fluoranthene	2,270	550	237	36 U	660	308	805
Pyrene	4,130	907	232	38 U	924	395	1,318
Benzo(a)anthracene	1,640	335	121	36 U	331	86	503
Chrysene	1,890	387	201	36 U	354	131	593
Benzo(b)fluoranthene	1,450	298	247	36 U	374	146	503
Benzo(k)fluoranthene	656	133	97	36 U	125	52	213
Total Benzofluoranthene	2,106	431	344	36 UT	499	198	716
Benzo(a)pyrene	1,430	271	158	36 U	394	83	467
Indeno(1,2,3-cd)pyrene	669	136	106	36 U	190	55	231
Dibenz(a,h)anthracene	180	28 J	30 J	36 U	43	12 J	59
Benzo(g,h,i)perylene	654	128	98	36 U	213	62	231
Total HPAH	*14,969*	*3,173*	*1,528*	*38 U*	*3,608*	*1,331*	*4,922*
Total B(a)P equiv. (µg/kg-DW)	*1,994*	*377*	*237*	*36 U*	*528*	*125*	*652*
PAHs µg/kg TOCN							
Naphthalene	6,360	3,170 J	37 U	--	1,092	33,143	10,941
Acenaphthylene	2,573 J	1,638 J	2,400 J	--	771	5,300	2,536
Acenaphthene	30,133	6,702	1,555 J	--	1,825	4,614	8,966
Fluorene	29,600	6,851	2,155 J	--	2,188	5,214	9,201
Phenanthrene	296,000	67,553	12,545	--	22,583	31,000	85,936
Anthracene	97,067	21,277	7,336	--	6,833	12,686	29,040
Total LPAH	*461,733*	*107,191*	*25,991*	--	*35,292*	*91,957*	*144,433*
Fluoranthene	302,667	58,511	21,545	--	27,500	44,000	90,845
Pyrene	550,667	96,489	21,091	--	38,500	56,429	152,635
Benzo(a)anthracene	218,667	35,638	11,000	--	13,792	12,271	58,274
Chrysene	252,000	41,170	18,273	--	14,750	18,714	68,981

Table 3-3—Surface Sediment Background[a] Concentrations of COPCs

Compound	Concentration						
	Phase 1				Phase 2		Average
	BK001	BK001D[b]	BK002	BK003	BK001	BK004	Background
Total Benzofluoranthene	280,800	45,851	31,291	--	20,792	28,343	81,415
Benzo(a)pyrene	190,667	28,830	14,364	--	16,417	11,914	52,438
Indeno(1,2,3-cd)pyrene	89,200	14,468	9,636	--	7,917	7,800	25,804
Dibenz(a,h)anthracene	24,000	2,936 J	2,764 J	--	1,771	1,771 J	6,648
Benzo(g,h,i)perylene	87,200	13,617	8,927	--	8,875	8,871	25,498
Total HPAH	*1,995,867*	*337,511*	*138,891*	--	*150,313*	*190,114*	*562,539*
Total B(a)P equiv. (µg/kg-TOCN)	*265,913*	*40,129*	*21,543*	--	*21,984*	*17,872*	*73,488*
Dioxins							
2,3,7,8-TCDD equiv. (ng/kg-DW)[f]	0.62	0.52	4.03	0.18	0.29	0.67	1.05
2,3,7,8-TCDD equiv. (ng/kg-TOCN)[f]	82.55	55.11	366.27	NA	12.08	95.71	122.35
PCBs							
Total PCBs (µg/kg-DW)[c]	6	11	50	2	23 U	199	54
Total PCBs (µg/kg-TOCN)[c]	773	1138	4545	NA	23 U[d]	28249	8721
Inorganics							
Mercury (mg/kg-DW)	0.05	1.10	0.15	0.02	0.08	0.02	0.10
Conventional Parameters							
Total Organic Carbon (%)	0.75	0.94	1.10	0.29	2.40	0.70	1.03

DW: Dry-weight.

TOCN: Normalized to total organic carbon content.

NA: Normalization not appropriate; TOC content less than 0.5 percent.

U: Not detected at detection limit shown.

J: Estimate.

[a] Sediment background values derived from both Phase 1 and Phase 2 background samples.

[b] Field replicate at Station BK001.

[c] Total PCBs are represented by the sum of the detected Aroclors.

[d] Dry-weight.

[f] Methods used for deriving and summing 2,3,7,8-TCDD equivalents are described in Section 4.5.

--: Detection limit not normalized to TOC content.

Table 3-4—Summary Statistics for Surface Sediment COPCs

Constituent	# of Stations Analyzed	# of Detected Values	Frequency of Detection (%)	Detected Concentrations						# of Stations Exceeding Background		Frequency of Exceedance of Background (%)	
				Dry-Weight			TOC-Normalized						
				Minimum	Maximum	Location of Maximum	Minimum	Maximum	Location of Maximum	DW Comparison	TOC-Normalized Comparison	DW Comparison	TOC-Normalized Comparison
PCBs (µg/kg)													
Total PCBs	42	42	100	24	1340	EB06	3923	78182	EB08	39	29	93	74[a]
Dioxins/Furans (ng/kg)													
2,3,7,8-TCDD (Equiv.)	38	38	100	1.97	156	EB26	102	11819	EB05	38	34	100	97[b]
Inorganics (mg/kg)													
Mercury	53	53	100	0.02	4.2	EB12	–	–	–	44	–	83	–

– = Not applicable
[a]TOC-normalization was appropriate for only 39 stations; therefore, the frequency of exceedance is based on 39 stations, rather than 42 stations
[b]TOC-normalization was appropriate for only 35 stations; therefore, the frequency of exceedance is based on 35 stations, rather than 38 stations.

Table 3-5—Summary Statistics for Clam Whole Body Tissue COCs

Constituent	Stations Analyzed	# of Detected Values	Frequency of Detection (%)	Detected Concentrations Minimum	Detected Concentrations Maximum	Detected Concentrations Location of Maximum	# of Stations Exceeding Background	Frequency of Exceedance of Background (%)	Average Background ER[a]
PAHs (µg/kg LIPN)									
Naphthalene	9	3	33	2,593	5,556	EB104	0	0	--
Acenaphthylene	9	7	78	1,043	1,680	EB87	0	0	--
Acenaphthene	9	3	33	1,161	2,080	EB87	0	0	--
Fluorene	9	4	44	1,710	17,370	EB104	1	11	1.25
Phenanthrene	9	9	100	4,783	37,037	EB104	9	100	2.64
Anthracene	9	9	100	6,478	562,963	EB104	9	100	38.21
Total LPAH	9	9	100	12,304	625,963	EB104	9	100	18.90
Fluoranthene	9	9	100	11,870	295,926	EB104	9	100	12.72
Pyrene	9	9	100	51,304	437,037	EB104	9	100	16.48
Benzo(a)anthracene	9	8	89	9,481	79,355	EB67	5	56	3.49
Chrysene	9	9	100	15,222	96,296	EB104	9	100	8.86
Total Benzofluoranthenes	9	9	100	65,957	200,000	EB67	9	100	13.87
Benzo(a)pyrene	9	9	100	30,130	81,935	EB67	9	100	9.44
Indeno(1,2,3-cd)pyrene	9	9	100	8,696	19,935	EB67	9	100	4.23
Dibenz(a,h)anthracene	9	9	100	1,913	5,871	EB67	0	0	--
Benzo(g,h,i)perylene	9	9	100	8,778	17,645	EB67	9	100	4.02
Total HPAH	9	9	100	217,348	1,145,111	EB67	9	100	13.56
2-Methylnaphthalene	9	1	11	4,222	4,222	EB104	0	0	--
Other SVOCs (µg/kg LIPN)									
2-Chloronaphthalene	9	0	0	<12.2	<13.9	--	0	0	--
Carbazole	9	1	11	14,741	14,741	EB104	0	0	--
1-Methylnapthalene	9	0	0	<12.2	<13.9	--	0	0	--
Retene	9	0	0	<12.2	<13.9	--	0	0	--
PCBs (µg/kg LIPN)									
Total PCBs	9	8	89	4,815	18,710	EB106	5	56	1.71
Dioxins/Furans (ng/kg LIPN)									
2,3,7,8-TCDD (Equiv.)	9	9	100	69	243	EB60	9	100	5.19
Inorganics (mg/kg WW)									
Mercury	9	0	0	<0.08	<0.08	--	0	0	--

[a]Average ERs calculated using only those individual ERs greater than 1.0
LIPN: Normalized to lipid content.
WW: Wet-weight.
< Not detected at wet-weight detection limit shown.
-- Not applicable.

Table 3-6—Clam Whole-Body Tissue Background[a] Concentrations (Wet-Weight) of COPCs

Compound	Concentration		
	BK01[b]	BK04[b]	Average
SVOCs (µg/kg LIPN)			
2-Chloronaphthalene	13,842[d]	13,579[d]	13,842
2-Methylnapthalene	13,842[d]	--	13,842
Carbazole	68,947[d]	67,895[d]	68,947
Naphthalene	13,842[d]	--	13,842
Acenaphthylene	13,842[d]	13,579[d]	13,842
Acenapthene	13,842[d]	13,579[d]	13,842
Fluorene	13,842[d]	13,579[d]	13,842
Phenanthrene	3,789	3,789	3,789
Anthracene	13,842[d]	1,947	1,947
Total LPAH	3,789	5,737	4,763
Fluoranthene	7,263	8,316	7,790
Pyrene	11,684	9,895	10,790
Benzo(a)anthracene	13,842[d]	13,579[d]	13,842
Chrysene	4,158	5,263	4,711
Benzo(b)fluoranthene	6,000	9,632	7,816
Benzo(k)fluoranthene	2,526	13,579[d]	2,526
Total benzofluoranthenes	8,526	9,632	9,079
Benzo(a)pyrene	5,474	5,895	5,685
Indeno(1,2,3-cd)pyrene	13,842[d]	3,000	3,000
Dibenz(a,h)anthracene	13,842[d]	13,579[d]	13,842
Benzo(g,h,i)perylene	13,842[d]	3,053	3,053
Total HPAH	37,105	45,053	41,079
Total B(a)P Equiv.[e]	6,103	7,163	6,633
Dioxins/Furans (ng/kg LIPN)			
2,3,7,8-TCDD Equiv.[f]	5.26	42.11	23.7
PCBs (µg/kg LIPN)			
Total PCBs[c]	6,842[d]	6,842[d]	6,842
Inorganics (mg/kg)			
Mercury	0.08[d]	0.08[d]	0.08
Conventionals			
Lipid (%)	0.19	0.19	0.19

LIPN: Normalized to lipid content.

[a] Clam tissue background represented by Phase 2 samples collected at BK01 and BK04.

[b] Data represent composites of 60 clams.

[c] Total PCBs are represented by the sum of the detected Aroclors.

[d] Undetected at detection limit shown.

[e] Methods used for deriving and summing B(a)P equivalents are described in Section 6.1.

[f] Methods used for deriving and summing 2,3,7,8-TCDD equivalents are described in Section 4.5.

Table 3-7a—Summary Statistics for Phase 2 Fish Whole Body Tissue COPCs

Contaminant	# of Samples Analyzed	# of Detected Values	Frequency of Detection (%)	Detected Concentrations Minimum	Detected Concentrations Maximum	Detected Concentrations Location of Maximum	# of Samples Exceeding Background	Frequency of Exceedance of Background (%)	Average Background ER[a]
PCBs (µg/kg LIPN)									
Total PCBs	6	6	100	4,407	13,136	NORTH-R1	6	100	1.73
Dioxins/Furans (ng/kg LIPN)									
2,3,7,8-TCDD (Equiv.)	6	6	100	0.81	145	WEST-R2	3	33	11.34
Inorganics (mg/kg WW)									
Mercury	6	0	0	<0.08	<0.08	--	0	0	--

LIPN = Normalized to lipid content.
WW = Wet-weight.
[a] Average ERs calculated using only those individual ERs greater than 1.0.

Table 3-7b—Summary Statistics for Phase 2 Fish Fillet COPCs

Contaminant	# of Samples Analyzed	# of Detected Values	Frequency of Detection (%)	Detected Concentrations Minimum	Detected Concentrations Maximum	Detected Concentrations Location of Maximum	# of Samples Exceeding Background	Frequency of Exceedance of Background (%)	Average Background ER[a]
PCBs (µg/kg WW)									
Total PCBs	6	6	100	105	492	NORTH-R3	6	100	6.79
Dioxins/Furans (ng/kg WW)									
2,3,7,8-TCDD (Equiv.)	3	2	67	0.07	0.31	NORTH-R1	3	100	15.61
Inorganics (mg/kg WW)									
Mercury	6	0	0	<0.08	<0.08	--	0	0	--

WW = Wet-weight.
[a] Average ERs calculated using only those individual ERs greater than 1.0.

Table 3-8—Fish Tissue Background[a] Concentrations of Bioaccumulative COPCs

	Concentration													
	English Sole Whole Body							English Sole Fillet						
	Alki			Magnolia				Alki			Magnolia			
Compound	R1	R2	R3	R1	R2	R3	Average	R1	R2	R3	R1	R2	R3	Average
2,3,7,8-TCDD Eqiv. (ng/kg WW)[b]	0.09	0.30	0.07	0.01	0.15	0.13	0.13	2.6[d]	0.05	2.6[d]	0.07	0.07	0.07	0.07
2,3,7,8-TCDD Eqiv. (ng/kg LIPN)[b]	3.33	11.11	4.38	0.34	6.00	4.19	4.89	236[d]	6.82	413[d]	8.00	8.86	15.39	9.77
Total PCBs (µg/kg WW)[c]	32	31	197	53	81	165	93	12	24	17	95	52	30	38
Total PCBs (µg/kg LIPN)[c]	1,185	1,148	12,313	1,828	3,240	5,323	4,173	1,091	2,727	2,698	9,500	6,582	5,769	4,728
Mercury (mg/kg WW)	0.08[d]	0.08[d]	0.08[d]	0.08[d]	0.08[d]	0.08[d]	0.08	0.08[d]	0.08[d]	0.08[d]	0.08[d]	0.08[d]	0.08[d]	0.08

WW: Wet-weight.

LIPN: Normalized to lipid content.

[a] Fish tissue background values derived from replicate trawls associated with BK01 and BK03.

[b] Methods used for deriving and summing 2,3,7,8-TCDD equivalents are described in Section 4.5.

[c] Total PCBs represented by the sum of the detected Aroclors.

[d] Undetected at detection limit shown.

Table 3-9—Human Health Risk-Based Screening Concentrations for Contaminants in Seafood

Contaminant	Screening Concentration[1] (µg/kg-WW)
Anthracene	10,800
Benzo(g,h,i)perylene	NA
Carbazole	42.0
Fluoranthene	1,420
Fluorene	1,420
Phenanthrene	NA
Pyrene	1,080
Total Benzo(a)pyrene Equivalents[2]	0.113
Total 2,3,7,8-TCDD Equivalents[3]	0

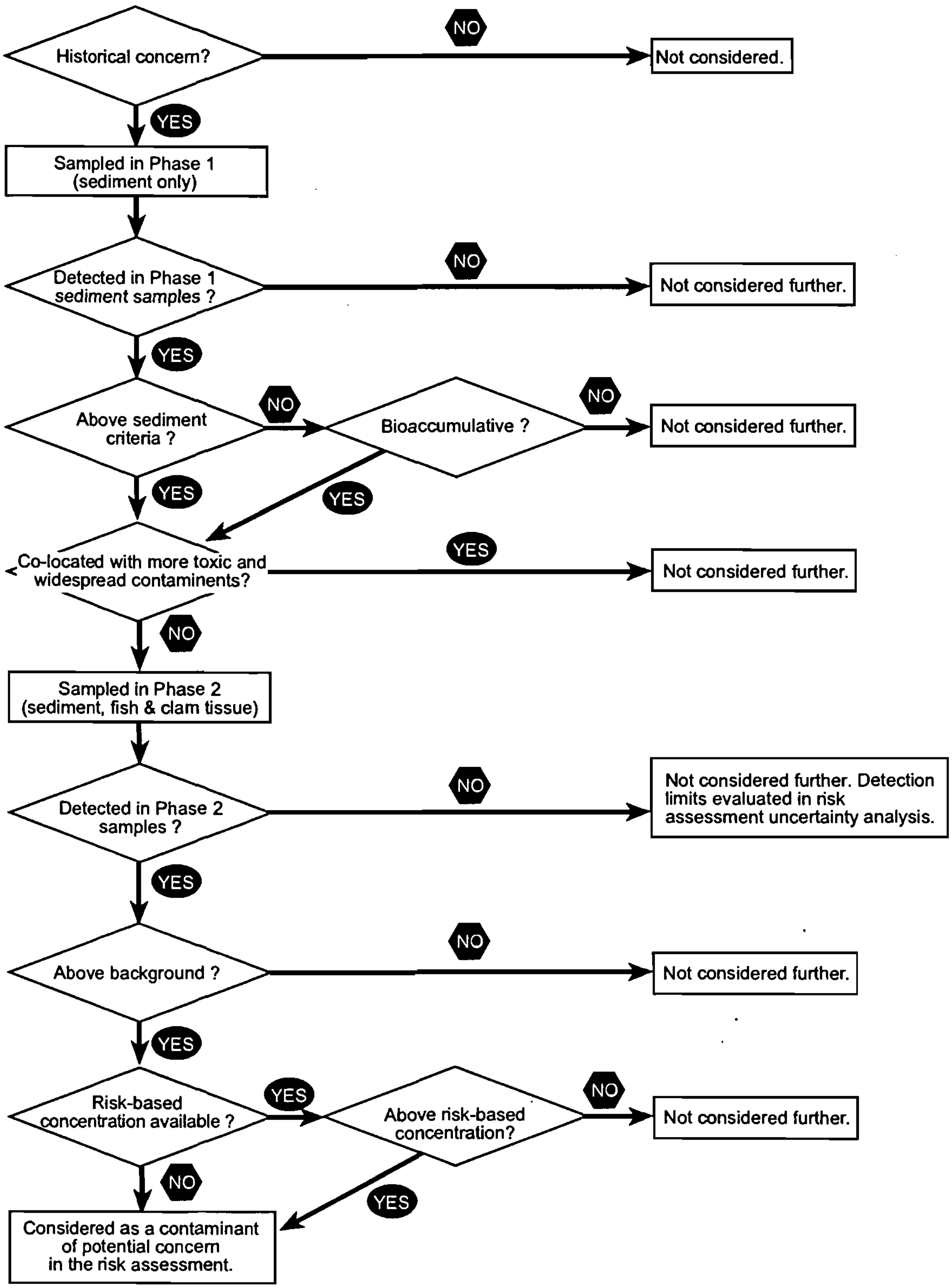
NA = No screening criterion available.

[1] Screening concentrations are based on EPA Region III Risk Based Concentration Table fish tissue values. They were adjusted to account for a higher consumption rate (205 g/day vs. 54 g/day); and the PCB concentration was adjusted to reflect updated cancer slope factor (2.0 per mg/kg-day vs. 7.7 per mg/kg-day).

[2] Includes Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, and Dibenz(a,h)anthracene.

[3] Includes all detected dioxin and furan compounds.

SECTION 3 FIGURES



PSR Marine Sediments Unit
Risk Assessment
Initial Contaminant Selection Process

WESTON® MANAGERS DESIGNERS/CONSULTANTS

98-0092 Fig4-1.FH7

FIGURE
3-1

SECTION 4

EXPOSURE ASSESSMENT

The objective of the exposure assessment is to identify potential exposure scenarios by which COPCs in site media may contact human and ecological receptors, and to quantify the intensity and extent of that exposure (EPA 1996b). Estimates of exposure rely on knowledge of the receptor and activities that affect a person's or organism's exposure along with the behavior of a chemical once it is released to the environment. The exposure assessment, along with the toxicity assessment (**Section 5**) forms the basis of the risk characterization (**Sections 6** and **7**).

4.1 HUMAN EXPOSURE ASSESSMENT

The human health exposure assessment identified current and potential future land uses, potentially exposed human populations, and potential exposure routes through which a person may come into contact with COPCs at the site. Both an individual representing a reasonable maximum exposure (RME) and an average exposure were evaluated to represent both current and potential future land-use scenarios. The RME is defined as the highest exposure that could reasonably be expected to occur for an individual and a given exposure pathway at a site. Risk-based decision-making primarily relies upon risks calculated for RME individuals. The estimate of average exposure is included for comparative purposes. Daily intake amounts of contaminants (i.e., the amounts of COPCs to which an individual would be exposed each day [mg/kg-day]) were calculated for each exposure pathway for both RME and average individuals under current and future conditions. Daily intakes for each case were calculated by varying exposure point concentrations and exposure parameters.

The objectives of the exposure assessment were to:

- Identify the exposure scenarios to be considered in the risk assessment based on current and potential future land use scenarios.

- Identify likely pathways of exposure to selected media containing COPCs.

- Calculate exposure point concentrations of COPCs in each medium associated with a significant exposure pathway to RME and average individuals.

- Calculate daily intakes of COPCs for each medium associated with a significant exposure pathway to RME and average individuals.

The exposure assessment includes identification of the following:

- Land use
- Media of concern
- Exposure scenarios
- Exposure routes
- Daily intake factors
- Exposure point concentrations
- Uncertainties associated with the exposure assessment

Each of these steps is discussed in the following paragraphs.

4.1.1 Land Use

The MSU of the PSR site is adjacent to a highly industrialized area of Elliott Bay. As stated in the RI/FS Work Plan (WESTON 1996b), members of the Muckleshoot and Suquamish tribes have Treaty fishing rights to fish the Duwamish River, the East and West waterways, and Elliott Bay. Thirty to forty tribal members are currently involved in drift-net fishing in Elliott Bay (Zilfshke 1992; Mahlovich 1992). Nets are trailed from boats in a semicircular pattern to trap schools of fish. To avoid snags, nets do not contact the bottom (thus, contact with sediment is limited). Set-net fishing is currently documented in the Duwamish River, but not in Elliott Bay.

No public beach areas are currently present at the site. A public access pathway following the shoreline of the PSR Upland Unit is currently being constructed as part of the Terminal 5 expansion project. Access to the shoreline and Elliott Bay from this pathway is planned to be restricted and physically blocked by a fence. A pier at the site will be accessible for viewing the Seattle waterfront but will also be enclosed by a fence (Port of Seattle 1997). Therefore, primary access to the site is expected to occur via boat. Based on anticipated conditions at the PSR site, the most likely continued use of the MSU is for the harvesting of fish and shellfish (primarily crab and shrimp).

4.1.2 Media of Concern

This human health risk assessment focuses on the MSU of the PSR site. Therefore, potential media of concern for the human health risk assessment include sediment, edible fish, and shellfish. The complete exposure pathways associated with media of concern are shown in the conceptual site model (RI **Figure 3-5**). Only fish and shellfish are directly evaluated in the human health risk assessment. The rationale for including or excluding a medium from the evaluation is discussed in the following sections.

4.1.2.1 Sediment

Sediment is not considered a primary medium of concern for human health and was not directly evaluated for the following reasons:

- Minimal intertidal sediment is present at the site.
- Access to the shoreline is restricted; therefore, direct contact with contaminated intertidal sediment is not likely to occur. Once cleanup has been completed, no contaminated sediment will be exposed in the intertidal area.
- Incidental contact with subtidal sediment is expected to be associated only with harvesting muddy nets or traps, and will be limited because the nearshore area associated with shallow depths is fairly small (bottom slopes rapidly and reaches depths greater than 20 meters a short distance from shoreline). This is particularly true for the drift-net fishing currently conducted in Elliott Bay because the nets do not directly sit on the sediments.
- Remediation of nearshore sediment, in more shallow water where set-net fishing could occur (although this type of fishing in Elliott Bay is not documented as a current use), will result in sediment concentrations approaching bay-wide background concentrations in those areas.

Based on measured concentrations of contaminants in sediment samples collected from the site, sediment is expected to be a primary source of contaminants to fish and shellfish at the site. Therefore, any cleanup actions that address potential human health risks due to consumption of fish and shellfish from the site will be directed at remediation of contaminated sediment.

4.1.2.2 Fish

Fish were chosen as a medium of concern because they were found to contain contaminants that were also detected in sediment from the MSU and that were associated with historical site activities. Both local and anadromous fish utilize the habitat at the site. However, due to the transitory nature of the anadromous fish and limited area of the site relative to the entire home range of these fish, only local bottom fish are expected to potentially accumulate significant amounts of contaminants from the site. Fish associated with bottom habitats that occur in the vicinity of the site include English sole and starry flounder. English sole were used in this study to represent potential exposure via fish consumption because of their abundance, extensive contact with sediments, and limited home range. Contaminant concentrations in fish vary depending on a variety of factors including the species of the fish, the size and lipid content of the fish, the feeding habits and home range of the fish, the type of fish tissue being evaluated, and contaminant-specific characteristics (e.g., whether contaminant is lipophilic or lipophobic). These factors are addressed in the uncertainty analysis. Because Native American tribal populations have been reported to consume primarily the fillets of the fish they catch (Toy et al. 1996), this analysis utilized concentrations measured in fish fillets.

4.1.2.3 Shellfish

Shellfish were also evaluated in the exposure assessment because edible shellfish (primarily crab and shrimp) are found at the site. As discussed in **Section 2**, numerous species of invertebrates use the aquatic habitats in the MSU during various life stages. Edible shellfish in the MSU may include clams, mussels, crabs, and shrimp. Clams, because of their close association with sediment and their potential for human consumption, were used to represent shellfish for this evaluation. However, most shellfish consumption related to this site is expected to come from shrimp and crab because of the limited intertidal habitat available and the restricted access to the shoreline. As with fish, contaminant concentrations in shellfish will vary depending on a variety of factors including the species of the shellfish, the size and lipid content of the shellfish, the feeding habits and home range of the shellfish, and contaminant-specific characteristics (e.g., whether contaminant is lipophilic or lipophobic). These factors are addressed in the uncertainty analysis.

4.1.3 Exposure Scenarios

Individuals may be exposed to site-related contaminants through consumption of fish and shellfish collected from the MSU. Fishing at the site may occur on a recreational or a subsistence basis. To ensure that actions taken at the site are protective of the individuals who utilize the site's resources, risk calculations are based on a tribal fisher scenario. As discussed in **Section 2**, a tribal fisher represents a type of subsistence fisher that fishes in the Puget Sound area. Both an average tribal fisher scenario and an RME tribal fisher scenario were evaluated to show the range of potential risks present at the site. Cancer risks were evaluated over a lifetime, while noncancer impacts were evaluated separately for adults and children (considered in the human health risk assessment as birth through age five). Due to their small body size, children less than six years old might have the potential for a greater intake (per kg body weight) of pollutants than an adult, and therefore, may be at higher risk.

4.1.4 Routes of Exposure

In order for a chemical to pose a human health risk, a complete exposure pathway must be present. A complete exposure pathway consists of the following elements:

- A source (e.g., historical upland site activities) and mechanism of chemical release to the environment (e.g., disposal in the MSU).

- An environmental transport medium (e.g., particulate deposition, bioaccumulative uptake) to carry the released chemical to a medium that will be in direct (e.g., fish tissue) or indirect (e.g., sediment via fish ingestion) contact with a person.

- An exposure point (i.e., a point of potential human contact with the contaminated medium) that includes a location where people are present and at which there is activity that results in exposure (referred to as an "exposure scenario").

- An exposure route (e.g., ingestion of potentially contaminated fish) at the exposure point.

Potential pathways of exposure in the MSU were evaluated according to these criteria. An exposure pathway was addressed in the risk assessment if all criteria were met. Exposure pathways are depicted in more detail in RI **Figure 3-5**.

4.1.5 Daily Contaminant Intakes

Quantifying the magnitude, frequency, and duration of exposure for the selected populations and exposure pathways is the next step in the exposure assessment. The first step of quantifying exposure is to determine the relative amount of fish or shellfish to which a person is exposed with respect to a person's body weight, exposure period, and time over which effects may be felt. This quantity is referred to as a summary intake factor. The summary intake factor for a given medium (i.e., fish or shellfish) is multiplied by the concentration of a given chemical in that medium to determine an individual's estimated daily intake of a chemical from that medium. **Table 4-1** presents the equations used to calculate estimated daily intakes for evaluating carcinogenic and noncarcinogenic human health risks.

Six basic factors were used to calculate estimated daily intakes: exposure frequency, exposure duration, ingestion rate, chemical concentration in the medium of concern, body weight of the exposed individual, and averaging time. In this assessment, exposure levels were normalized for time and body weight, and are expressed in milligrams of chemical per kilogram of body weight per day (mg/kg-day). The exposure factors and algorithms used to quantify daily intakes are presented in **Table 4-1**. These factors and algorithms are based on and consistent with EPA's general risk assessment guidance for Superfund (EPA 1989a; 1991a) as well as EPA's Standard Default Exposure Factors (EPA 1991b) except where noted.

Each variable listed in **Table 4-1** may be represented by a range of possible values. For risk assessments conducted utilizing EPA Region X Supplemental Risk Assessment Guidance for Superfund (EPA 1991a), the intake variable values for a given pathway are selected so that the combination of all intake variables results in a realistic upper-bound estimate, or reasonable maximum exposure (RME), for that pathway. In concert with EPA risk characterization guidance (EPA 1995b), an average intake is also calculated to represent a level of exposure more consistent with a greater fraction of the population. The RME scenario is used for risk management decisions and the average scenario is used to help depict the range of risks relevant to site conditions.

Of the fish at the PSR site, bottom fish such as sole and flounder are of primary concern in estimating exposure. These bottom fish tend to remain in a localized areas (at least on a seasonal basis) and frequently contact the sediment and ingest other sediment-dwelling biota that may have been directly impacted by the site. Anadromous fish such as salmon, and pelagic fish (fish that inhabit the water column) in general, were not of as great a concern because their home range is so large that any impact they may have received due to environmental contamination cannot be directly linked to a single source (e.g., the MSU of the PSR site). Because it is not reasonable to gather contaminant concentration data for all species of bottom fish that may occur in the MSU, English sole were used as a surrogate species to represent bottom fish in this evaluation. Edible shellfish, such as clams, are exposed to contaminants at the site primarily through contact with contaminated sediment. Clams were used as a surrogate for all shellfish in this evaluation.

The findings of a fish consumption survey of the Tulalip and Squaxin Island tribes of Puget Sound were released in 1996 (Toy et al. 1996). Consumption rates of both fish and shellfish used in this assessment to represent tribal fishing exposures were based on data in this study because it represents Native American fish and shellfish consumption patterns specific to the Puget Sound area. Data from this study were also used to modify the portion of consumed fish that are likely to be acquired from the PSR MSU. Only the fraction of fish and shellfish obtained from Puget Sound, as opposed to seafood obtained at restaurants, grocery stores, or from remote fishing sites (e.g., Alaska), were expected to represent fish and shellfish that may come from the PSR site. A weighted average of data from the two tribes evaluated in the Toy et al. study (1996) was applied to PSR risk calculations. Additionally, since the PSR site can provide only a limited number of shellfish species that compose a subsistence individuals diet, only the fraction of total shellfish consumed representing those shellfish species (i.e., crab and shrimp) available at the site was considered in the risk assessment. A weighted average of shellfish species-specific consumption data from the two tribes evaluated in the Toy et al. study, as reported in a memo providing a more detailed analysis of the shellfish consumption data (Liao and Polissar 1996), was applied to PSR risk calculations.

Finally, exposure frequency was modified to reflect half of the default value (every day of the year minus two weeks spent off-site). This decreased exposure frequency accounts for the fact that the duration of harvesting is regulated to occur only from mid-April through mid-October. Additional regulations on commercial fishing limit both Native American and non-Native American fishers to a certain amount of catch, which may be reached before the allowable harvest time is over (Cain 1997).

4.1.6 Exposure Point Concentrations

Exposure point concentrations were calculated for each COPC in each medium. A value of one-half of the sample quantitation limit was assumed for contaminants not detected in a given sample. The RME exposure point concentration was represented by the 90th percentile value, per Washington State MTCA guidance. The average exposure point concentration was represented by the arithmetic mean.

Exposure point concentrations were calculated for both fish fillets and shellfish tissue. Separate exposure point concentrations were calculated to represent current conditions at the site, and projected conditions at the site, following different cleanup scenarios. Since cleanup scenarios were based on remediation of contaminated sediment from given areas of the site (as described in **Section 1**), projected conditions were represented by decreases in site-wide sediment concentrations. Sediment contaminant concentrations in areas associated with a cleanup action were replaced with Elliott Bay sediment background concentrations for each contaminant. Subsequently, overall residual sediment concentrations were calculated based on existing sample concentrations for areas not associated with cleanup actions and background concentrations for samples from areas associated with cleanup actions. Sediment concentrations under current conditions and following different cleanup scenarios for contaminant of potential concern to human health due to fish and shellfish consumption are presented in **Table 4-2**. Sediment concentrations were calculated using both the mean and the 90th percentile to represent both average and above-average exposures associated with the site.

Fish and shellfish exposure point concentrations were extrapolated from sediment contaminant concentrations. While human health COPCs for shellfish and fish were selected based on the nine clam samples exposed to sediment from the site and six fillet composites from two trawls, these samples were considered insufficient to reflect changes in conditions to the overall site and fish or shellfish throughout the site, following proposed cleanup actions. Therefore, in order to represent concentrations of contaminants throughout the entire site, and possible changes to these concentrations following potential cleanup actions, a linear bioaccumulation model, as shown by the equations in **Table 4-3a** and **b**, was used to predict fish and shellfish tissue concentrations. Chemical-specific BSAF values presented in **Table 4-4** were used in these calculations. Both mean and 90th percentile values were calculated. Human health exposure point concentrations for COPCs in fish and shellfish tissue are shown in **Table 4-5** and **4-6**, respectively.

4.1.7 Exposure Assessment Uncertainties

A variety of assumptions applied to the human health exposure assessment are associated with uncertainties that affect how much confidence, or certainty, can be placed in resulting risk estimates. Uncertainties associated with the exposure assessment include the following:

- *Limited access to shoreline.* Should the current plan to block access to the shoreline and to fishing from the shore or the pier not be implemented, additional concerns regarding human contact with contaminated sediment in the banks under current conditions could be raised; and risks for current conditions could be underestimated for individuals exposed through this pathway.

- *Home range of bottom fish.* Bottom fish collected from the site were assumed to accumulate 100 percent of their contaminant body burden from contaminated site media. Should the home range of these fish extend significantly beyond the boundaries of the site, site-specific risks calculated for current conditions would be overestimated. Conversely, because of the proportional reduction in contamination assumed to occur in fish with respect to post-cleanup site sediment concentrations, residual risk estimates following each potential phase of cleanup may be underestimated.

- *Use of bioaccumulation model to predict site-wide shellfish tissue concentrations.* Shellfish tissue concentrations were calculated from sediment concentrations using a site-wide average lipid fraction from nine clam tissue samples and literature-based biota sediment accumulation factors. If lipid measurements from nine laboratory bioassay clam tissue samples are not representative of site-specific edible shellfish lipid concentrations, risks may be over- or underestimated. (Lower lipid concentrations would be expected to result in less bioaccumulation of non-polar organic contaminants and, therefore, lower exposures.) Also, literature-based biota-sediment accumulation factors, which represent several shellfish species, may over- or underestimate bioaccumulation of COPCs in edible shellfish species present at the site.

- *Use of surrogate fish species.* English sole were used to represent contaminant concentrations in bottom fish at the site. Bioaccumulation of contaminants is dependent on many species-specific properties, including lipid content. Some species may have higher lipid content than those chosen, and some may have lower lipid content. Therefore, the use of surrogate species may result in an over- or under-estimate of overall risks at the site.

- *Use of tribal fishers to represent subsistence fishing at the site.* Because two Native American tribes have documented fishing rights to areas including the site, this scenario was used as a realistic representation of a subsistence type of fishing scenario for the site. The use of tribal fishers may result in either an over- or underestimation of risks to a subsistence fisher.

- *Use of fish fillets.* Based on habits of other Puget Sound tribes (as reported in Toy et al. 1996) contaminant concentrations were measured in fish fillets only. Should individuals consume additional portions of the fish, such as the skin or the head, risks may be under- or over-estimated, depending on the difference in concentrations between those parts of the fish and the fillet.

- *Use of default exposure duration.* The RME scenario was evaluated using a 30 year default exposure duration. Should an individual subsist on fish from the PSR site over a full lifetime, or any time longer than 30 years, risks may be underestimated. If all individuals subsisting on fish and shellfish from the PSR site utilize the site for less than 30 years, risks may be overestimated.

- *Assumption that 100 percent of consumed fish and mobile shellfish gathered from Puget Sound are from site.* Risks were calculated assuming that all bottom fish and shellfish collected by exposed individuals from Puget Sound would come from the PSR site. Should these individuals collect their bottom fish or shellfish from additional sites in Puget Sound, site-specific risks are overestimated.

- *Assumption that only crabs and other mobile shellfish may be gathered from the site.* Based on available habitat and observed current populations of sessile shellfish (such as clams), people were assumed to harvest only crabs and other mobile shellfish from the site. Should accessible populations of edible sessile shellfish increase at the site, risks may be underestimated.

- *Small sample size of fish and shellfish.* Only six fish fillet samples and nine clam samples were available for analysis. A larger sample size may have resulted in an increase or decrease to risk estimates. The most significant impact of a larger sample size would be increased precision for predicting changes in residual risks following cleanup.

- *Use of reduced exposure frequency.* A six months per year exposure frequency was used to reflect the limited harvesting season (mid-April through mid-October). Should the harvesting season be extended, and resources be sufficient to accommodate this extension, risks may be underestimated. Current information suggests that harvest quotas are often reached in less than six months (6 to 8 weeks), which would potentially result in an overestimation of risk.

- *Use of arithmetic mean to represent exposure point concentrations.* An arithmetic mean is recommended by EPA for representing average exposure point concentrations. If site-specific data are distributed in a lognormal distribution, an arithmetic mean may overestimate exposure point concentrations.

- *Assumption of constant contaminant concentrations.* Contaminant concentrations were assumed to remain constant over the exposure period considered. Should contaminants degrade, be washed away or be diluted over time, risks may be overestimated.

- *Use of one half the detection limit.* The use of half the detection limit for samples with undetected contaminants (a.k.a. "nondetects") introduces uncertainty in deriving representative exposure point concentrations, as the actual value is unknown. This uncertainty may cause either overestimates or underestimates of the actual concentrations present. One alternative to using half the detection limit is using the full detection limit. This approach eliminates the possibility of underestimating exposure point concentrations but likely results in overestimates of both exposure point concentrations and risks. Another alternative is eliminating nondetects from consideration. If a particular contaminant has been detected in other samples in the off-source area, this approach would likely underestimate exposure point concentrations, and consequently underestimate risk.

- *Assumption that contaminants are 100 percent bioavailable.* All contaminants are expected to be 100 percent bioavailable to people. It is likely that some contaminants, due to chemical form or other factors, may not be completely bioavailable to people. In such a case, risks will be overestimated.

These uncertainties are discussed in more detail with particular regard to actual risk estimates in the human health risk characterization (**Section 6**).

4.2 ECOLOGICAL EXPOSURE ASSESSMENT

The ecological exposure assessment evaluates the ecological receptors selected in **Section 2** for use in the risk assessment, their habitat, and the expected distribution of COPCs in the media (e.g., sediment) through which they are exposed. This information is used to establish chemical-specific exposure point concentrations for evaluating effects to selected ecological receptors. Exposure to benthic organisms was also represented by measures of abundance and diversity within the benthic community.

4.2.1 Sediment

Because receptors within the benthic community are expected to have limited movement (most are sessile) and are more likely to spend their entire lives at single, defined locations within the sediment environment, contaminant-specific sediment concentrations were presented on a station-by-station basis, rather than combining the exposures from all nine stations. The contaminant-specific exposure point concentrations for surface sediment collected at stations where concurrent biological testing was performed are presented in **Table 4-7**. The effects to benthic infauna under future cleanup scenarios were evaluated based on the number of stations that would be cleaned up relative to the number that were sampled.

As described in **Section 3.2**, the concentrations of specific organics were normalized to the TOC content of the sediment to represent the bioavailable fraction of those contaminants, where TOC normalization was considered appropriate for this site (i.e., where TOC concentrations were between 0.5 and 4.0 percent). In addition, the summing of particular chemical classes (e.g., total

LPAHs, total HPAHs) and conversion of dioxin and furan congener-specific data to 2,3,7,8-TCDD equivalents was conducted in accordance with the procedures specified in **Section 3**.

4.2.2 Benthic Infaunal Community

The benthic infaunal community was represented by measures of abundance and diversity of specific organisms identified in sediment samples. As with sediment exposure point concentrations, these measures of exposure were examined on a station-by-station basis rather than in combination. Benthic exposures were represented based on the following:

- Mean abundance of each individual species and three major taxonomic groups (crustaceans, molluscs, polychaetes) were calculated from replicate samples for each station.

- Mean total abundance, mean total richness, and mean major taxonomic group richness were calculated from replicate samples for each station.

Appendix A includes benthic infaunal data used to represent exposed benthic communities.

4.2.3 Clams

Contaminant exposure to clams inhabiting the MSU was estimated by directly measuring the concentration of COPCs in unpurged, whole body bent-nosed clam tissues exposed to site sediments in a laboratory test. Future exposure of clams was evaluated for different cleanup scenarios by comparing the number of locations that would be cleaned up to the total number sampled.

The whole body tissue results are summarized in **Attachment K.8**. The procedures used to derive lipid-normalized tissue concentrations, compound totals (e.g., total LPAHs, total HPAHs), and 2,3,7,8-TCDD equivalent concentrations followed those described in **Section 3** for contaminant screening of clam tissues. As with other benthic exposure data, clam exposure point concentrations were represented by station.

4.2.4 Fish

Based on the approach to selecting receptors (WESTON 1996b) and the reconnaissance survey catch data obtained during Phase 2 (**Table 2-2**), English sole (*Pleuronectes vetulus*) were selected as the target species to support the risk assessment (WESTON 1997a). Catch data from the Phase 2 trawls is presented in **Table 4-8**. **Attachment K.7** contains the whole body fish tissue data.

4.2.4.1 Fish Tissue

Contaminant exposure based on bioaccumulation in English sole was estimated by directly measuring TCDD in whole body adult tissues. Concentrations of TCDD equivalents were presented as wet-weight as well as normalized to percent lipid content to minimize the effects of physiological condition and age of individual fish and to account for any lipid-related concentration differences between trawls within the same transect. Lipid normalization was performed by dividing the measured wet-weight concentration by the sample-specific decimal fraction of lipid.

Percent lipids and TCDD concentrations were based on a composite of multiple fish collected during a single trawl. Three individual trawls were conducted at each transect (RI **Figure 1-5**) and treated as replicates of that area of the site. The results from each whole body tissue composite from each trawl were averaged to obtain average MSU TCDD, and lipid values for fish.

For complex mixtures of chlorinated dibenzo-p-dioxins and dibenzofurans, EPA (1989b) recommends the use of toxicity equivalents. The resulting congener-specific concentration is expressed in terms of 2,3,7,8-tetrachlorodibenzo-p-dioxin equivalents or TCDD. For consistency with the approach to data summing used in the SMS, sums were calculated using detected concentrations only. TEFs used in the calculations are presented in **Table 3-2**. Future exposure scenarios for fish tissue concentrations were developed by extrapolating fish tissue concentrations from average sediment concentrations under different cleanup scenarios using a linear bioaccumulation model, similar to the approach used for the human health assessment.

Whole body English sole tissue sampling results are summarized in **Attachment K.7**. The averages for total TCDD equivalents in whole body tissues are provided in **Table 4-9**.

4.2.4.2 Egg Tissue

4.2.4.2.1 Maternal Transfer Rates

TCDD exposure to the eggs of English sole was estimated using a maternal-egg transfer approach. The maternal-egg transfer approach is based on the premise that bioaccumulative contaminants are transferred from the female to egg tissues at specific rates. These rates (expressed as the percentage of contaminant transferred from material tissue to egg tissue) are influenced by several factors including the type of contaminant, the age and type of fish, and the lipid content of the tissues involved. Studies from Niimi (1983) and EPA (1993a) were used as a basis for the maternal transfer of TCDD.

<u>TCDD</u>

The accumulation of TCDD in eggs largely reflects maternal transfer. EPA (1993a) provides a thorough report on the data and methods for assessing the bioaccumulation and transfer of TCDD and associated risks in aquatic life and other wildlife. In EPA (1993a), studies by Spitzbergen et al. (1991) and Walker et al. (1991) showed maternal transfer rates of approximately 50 percent for lake trout (*Salvelinus namaycush*) fed dietary levels of TCDD. Because the concentration of TCDD in eggs following maternal transfer (i.e., the egg dose) varied within and among the exposure groups, no definite relationship could be determined between the targeted dietary exposure levels of TCDD in the females and the egg TCDD dose spawned from these fish. In other laboratory tests with maternal transfer, eggs were determined to have about 40 percent of the TCDD concentration (based on wet weight) of the parent fish. For fish collected from Lake Ontario, this percentage was about 30 percent (wet weight). To ensure that risk calculations adequately reflect highly sensitive fish at the site, a 50 percent transfer rate was used in this assessment as the wet-weight transfer of TCDD between maternal and egg tissues in English sole. Estimates of the egg tissue concentrations are provided in **Table 4-10**.

SECTION 4 TABLES

Table 4-1—Estimated Daily Intakes for Fish and Shellfish Consumption

$$EDI_{noncancer} = \frac{conc_{fish} \times IR \times EF \times ED \times f_{PS} \times f_{species} \times f_{utilization} \times CF_1 \times CF_2}{BW \times AT_{noncancer} \times CF_3}$$

$$EDI_{cancer} = \frac{conc_{fish} \times IR_{twa} \times EF \times (ED_a+ED_c) \times f_{PS} \times f_{species} \times f_{utilization} \times CF_1 \times CF_2}{BW_{twa} \times AT_{cancer} \times CF_3}$$

$$IR_{twa} = \frac{IR_a \times ED_a + IR_c \times ED_c}{ED_a + ED_c}$$

$$BW_{twa} = \frac{BW_a \times ED_a + BW_c \times ED_c}{ED_a + ED_c}$$

		Exposure via Fish Consumption				Exposure via Shellfish Consumption			
Parameter	Parameter Description	Adult RME	Adult Average	Child RME	Child Average	Adult RME	Adult Average	Child RME	Child Average
EDI	estimated daily intake (for cancer or noncancer, as indicated)	---	---	---	---	---	---	---	---
$conc_{fish}$	concentration of contaminant in fish (µg/kg)	chem spec	chem spec	chem spec	chem spec	chem spec	chem spec	chem spec	chem spec
IR[1]	human daily ingestion rate of fish (g/day)	15.96	1.05	0.465	0.465	91.56	8.05	8.61	0.18
EF	human exposure frequency to scenario involving consumption of fish (days/yr)	175	175	175	175	175	175	175	175
ED	human exposure duration to scenario involving consumption of fish (years)	24	24	6	6	24	24	6	6
f_{PS}	fraction of fish consumed that are obtained from Puget Sound (unitless)	0.21	0.21	0.21	0.21	0.67	0.67	0.67	0.67
$f_{species}$	fraction of types of fish/shellfish species consumed that may be obtained from the site (unitless)	1	1	1	1	0.49	0.34	0.49	0.34
$f_{utilization}$	fraction the site represents of total sites utilized by individuals in Puget Sound to harvest fish/shellfish (unitless)	1	1	1	1	1	1	1	1
BW[1]	body weight of person (kg)	70	70	15	15	70	70	15	15
AT_{cancer}	averaging time over which carcinogenic exposure should be considered--usually considered as a lifetime (years)	70	70	NA	NA	70	70	NA	NA
$AT_{noncancer}$	averaging time over which noncarcinogenic exposure should be considered--usually considered as equal to the exposure duration (years)	24	24	6	6	24	24	6	6
CF_1	converts chem conc in fish from µg to mg (mg/µg)	1.00E-03	1.00E-03	1.00E-03	1.00E-03	0.001	0.001	0.001	0.001
CF_2	converts ingestion rate from g to kg (kg/g)	1.00E-03	1.00E-03	1.00E-03	1.00E-03	0.001	0.001	0.001	0.001
CF_3	converts avg time from years to days (days/yr)	365	365	365	365	365	365	365	365
Carcinogenic Estimated Summary Intake Factor[2] (1/day)		8.96E-08	6.50E-09	---	---	5.22E-07	4.51E-08	---	---
Noncarcinogenic Estimated Summary Intake Factor[2] (1/day)		2.19E-07	1.44E-08	2.97E-08	2.97E-08	1.25E-06	1.10E-07	5.50E-07	1.15E-08

Sources: EPA 1991a; 1991b; Toy et al 1996; Liao and Polissar 1996.

a = adult.

c = child.

[1] Time-weighted averages (twa) were calculated to represent body weight and ingestion rate over the total exposure duration (childhood and adulthood) for cancer risks.

[2] The summary intake factor is multiplied by the contaminant-specific exposure point concentration to calculate the estimated daily intake of a given constituent.

Table 4-2—Residual Sediment Chemical Concentrations at the Marine Sediments Unit of the PSR Superfund Site

Chemical	Current Conditions		Post CSL Cleanup		Post SQS Cleanup		Post Risk-Based Cleanup	
	Mean	90th Percentile	Mean	90th Percentile	Mean	90th Percentile	Mean	90th Percentile
Dry-Weight Concentrations								
PAHs (µg/kg-DW)								
Naphthalene	9462	14080	391	1128	116	136	84	84
Acenaphthylene	456	992	54	109	26	25	23	23
Acenaphthene	13688	7574	205	428	80	76	75	76
Fluorene	7576	6148	212	446	86	84	79	80
Phenanthrene	30170	17280	992	1484	700	750	731	750
Anthracene	28947	7376	402	690	246	252	247	252
Total LPAH	90429	56965	2330	4520	1244	1249	1222	1249
Fluoranthene	44051	31860	1260	1912	777	805	790	805
Pyrene	30848	49520	1784	2748	1247	1318	1285	1318
Benzo(a)anthracene	8043	9172	551	726	467	503	490	503
Chrysene	10726	10600	790	1134	569	593	580	593
Benzo(b)fluoranthene	6426	12200	826	1200	514	503	493	503
Benzo(k)fluoranthene	2410	3910	300	458	214	213	208	213
Total Benzofluoranthene	8255	12896	1111	1647	729	716	702	716
Benzo(a)pyrene	3273	5682	577	808	451	467	455	467
Indeno(1,2,3-cd)pyrene	1105	1712	275	383	226	231	225	231
Dibenz(a,h)anthracene	347	463	74	112	59	59	57	59
Benzo(g,h,i)perylene	927	1396	261	356	224	231	225	231
Total HPAH	91514	116978	6682	9679	4748	4922	4808	4922
Total B(a)P equivalent	5193	7993	822	1192	635	652	636	652
Dioxins (ng/kg-DW)								
Total 2,3,7,8-TCDD(Equiv)	27	59	3	8	1	1	1	1

Table 4-3a—Estimation of Shellfish Concentrations

$$conc_{shellfish} = \frac{conc_{sediment} \times f_{lipid} \times BSAF}{f_{TOC}}$$

Parameter	Parameter Description	Shellfish Value
$conc_{shellfish}$	concentration (µg/kg) of contaminant in clam	chem specific
$conc_{sediment}$	concentration (µg/kg-DW) of contaminant in sediment	chem specific
f_{lipid}	site-specific fraction of lipid in shellfish	0.0026
BSAF	Biota Sediment Accumulation Factor (g-oc/g_{lipid}) for transfer of contaminant from sediment to clam	chem specific
f_{TOC}	Site-specific fraction of organic carbon in the sediment (unitless)	0.0183

Table 4-3b—Estimation of Fish Fillet Concentrations

$$conc_{fish\ fillet} = \frac{conc_{sediment} \times f_{lipid} \times BSAF}{f_{TOC}}$$

Parameter	Parameter Description	Fish Fillet Value
$conc_{fish\ fillet}$	concentration (µg/kg) of contaminant in fish fillet	chem specific
$conc_{sediment}$	concentration (µg/kg-DW) of contaminant in sediment	chem specific
f_{lipid}	site-specific fraction of lipid in fish fillet	0.017
BSAF	Biota Sediment Accumulation Factor (g-oc/g_{lipid}) for transfer of contaminant from sediment to fish	chem specific
f_{TOC}	Site-specific fraction of organic carbon in the sediment (unitless)	0.0183

Table 4-4—Summary of Fish and Shellfish BSAFs

Contaminant	log(Kow)	BSAF Fish	BSAF Shellfish	Reference
TCDD	7.25	0.99	0.99[2]	PTI, 1995; WDOH, 1995
PAHs	6.25	0.38	0.38	PTI, 1995; WDOH, 1995

[1] Log(Kow) was based on selecting a value from PTI (1995) closest to the 75th percentile value as grouped by chemical class from WDOH (1995) data. BSAFs were then calculated for each contaminant based on the 90th upper confidence limit using the log(Kow) in the following third order polynomial equation:
$Log(BSAF) = C_1 \times (log(Kow)) + C_2 \times (log(Kow))^2 + C_3 \times (log(Kow))^3 + B$
where:
C_n = Log(Kow) coefficient.
B = Regression constant.

[2] The BSAF for TCDD in fish was chosen to represent the BSAF for TCDD in shellfish because no value was available for TCDD in shellfish. This is supported by the fact that PCBs, which have some similar properties to TCDD, have similar BSAFs for fish and shellfish.

Table 4-5—Residual Fish Fillet Chemical Concentrations (µg/kg-WW) from the Marine Sediments Unit of the PSR Superfund Site

Chemical	Current Conditions		Post CSL Cleanup		Post SQS Cleanup		Post Risk-Based Cleanup		Background
	Mean	90th Percentile	Mean	90th Percentile	Mean	90th Percentile	Mean	90th Percentile	Mean
Total 2,3,7,8-TCDD(Equiv)	0.0251	0.0503	0.0029	0.0073	0.0014	0.0010	0.0010	0.0010	0.0009

Current and background are based on Round 2 data.
All other concentrations are estimated based on BSAF model.

Table 4-6—Residual Clam Tissue Concentrations at the Marine Sediments Unit of the PSR Superfund Site

Chemical	Current Conditions		Post CSL Cleanup		Post SQS Cleanup		Post Risk-based Cleanup		Background
	Mean	90th Percentile	Mean	90th Percentile	Mean	90th Percentile	Mean	90th Percentile	Mean
Wet-Weight Concentrations									
PAHs (µg/kg-WW)									
Naphthalene	511	760	21	61	6	7	5	5	26
Acenaphthylene	25	54	3	6	1	1	1	1	26
Acenaphthene	739	409	11	23	4	4	4	4	26
Fluorene	409	332	11	24	5	5	4	4	26
Phenanthrene	1629	933	54	80	38	41	39	41	7
Anthracene	1563	398	22	37	13	14	13	14	7
Total LPAH	4882	3075	126	244	67	67	66	67	7
Fluoranthene	2378	1720	68	103	42	43	43	43	15
Pyrene	1665	2674	96	148	67	71	69	71	21
Benzo(a)anthracene	434	495	30	39	25	27	26	27	26
Chrysene	579	572	43	61	31	32	31	32	9
Benzo(b)fluoranthene	347	659	45	65	28	27	27	27	15
Benzo(k)fluoranthene	130	211	16	25	12	11	11	11	5
Total Benzofluoranthene	446	696	60	89	39	39	38	39	17
Benzo(a)pyrene	177	307	31	44	24	25	25	25	11
Indeno(1,2,3-cd)pyrene	60	92	15	21	12	12	12	12	6
Dibenz(a,h)anthracene	19	25	4	6	3	3	3	3	26
Benzo(g,h,i)perylene	50	75	14	19	12	12	12	12	6
Total HPAH	4941	6316	361	523	256	266	260	266	78
Total B(a)P equivalent	280	432	44	64	34	35	34	35	44
Dioxins and Furans (µg/kg-WW)									
Total 2,3,7,8-TCDD(Equiv)	0.00384	0.00825	0.00044	0.00111	0.00021	0.00015	0.00015	0.00015	0.00004

All concentrations are estimated based on BSAF model with the exception of background concentrations, which are represented by actual measurements conducted as part of the Phase 2 sampling event.

Table 4-7 - Surface Sediment Exposure Concentrations

Constituent	Station ID:	EB049	EB060	EB067	EB077	EB080	EB085
	Sample ID:	SD2-EB49-0000	SD2-EB60-0000	SD2-EB67-0000	SD2-EB77-0000	SD2-EB80-0000	SD2-EB85-0000
	Depth (cm bgs):	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm
Semi-Volatile Organic Compounds (ug/kg)							
2-Chloronaphthalene		19.50 U	14.60 U	15.00 U	16.00 U	18.00 U	15.10 U
2-Methylnaphthalene		118.00	235.00	723.00	699.00	2720.00	2240.00
Carbazole		58.90	71.90	134.00	72.50	258.00	82.20
Naphthalene, 1-methyl		73.80	182.00	544.00	587.00	2170.00	1470.00
Retene		148.00	143.00	226.00	169.00	343.00	297.00
Naphthalene		314.00	946.00	3190.00	2530.00	11400.00	7260.00
Acenaphthylene		102.00	95.50	240.00	115.00	380.00	145.00
Acenaphthene		153.00	366.00	1150.00	955.00	4260.00	2720.00
Fluorene		212.00	372.00	1080.00	804.00	3510.00	2680.00
Phenanthrene		1000.00	1080.00	2870.00	2110.00	9870.00	7610.00
Anthracene		586.00	696.00	1610.00	765.00	2730.00	1920.00
Total LPAH		2367.00 T	3555.50 T	10140.00 T	7279.00 T	32150.00 T	22335.00 T
Fluoranthene		2290.00	1590.00	6670.00	2080.00	7690.00	5820.00
Pyrene		4590.00	1990.00	7320.00	2910.00	11300.00	6320.00
Benzo(a)anthracene		1400.00	672.00	1580.00	494.00	1360.00	902.00
Chrysene		2130.00	1290.00	2390.00	847.00	1980.00	1060.00
Benzo(b)fluoranthene		2840.00	1380.00	2300.00	1010.00	2250.00	1400.00
Benzo(k)fluoranthene		1250.00	556.00	922.00	359.00	882.00	436.00
Total Benzofluoranthene		4090.00 T	1936.00 T	3222.00 T	1369.00 T	3132.00 T	1836.00 T
Benzo(a)pyrene		2000.00	860.00	1310.00	577.00	1280.00	709.00
Indeno(1,2,3-cd)pyrene		1100.00	401.00	578.00	256.00	542.00	293.00
Dibenz(a,h)anthracene		360.00	118.00	196.00	74.60	168.00	84.70
Benzo(g,h,i)perylene		972.00	348.00	542.00	223.00	519.00	282.00
Total HPAH		18932.00 T	9205.00 T	23808.00 T	8830.60 T	27971.00 T	17306.70 T
Total B(a)P equivalent		2908.63 T	1230.15 T	1963.41 T	832.03 T	1874.00 T	1058.62 T

A blank cell indicates analysis was not performed.

Table 4-7 - Surface Sediment Exposure Concentrations

Station ID:	EB049	EB060	EB067	EB077	EB080	EB085
Sample ID:	SD2-EB49-0000	SD2-EB60-0000	SD2-EB67-0000	SD2-EB77-0000	SD2-EB80-0000	SD2-EB85-0000
Constituent / Depth (cm bgs):	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm
Semi-Volatile Organic Compounds - TOCN (ug/kg)						
2-Methylnaphthalene	5363.63	19583.33	42529.41	46600.00	123636.36	124444.44
Naphthalene	14272.72	78833.33	187647.05	168666.66	518181.81	403333.33
Acenaphthylene	4636.36	7958.33	14117.64	7666.66	17272.72	8055.55
Acenaphthene	6954.54	30500.00	67647.05	63666.66	193636.36	151111.11
Fluorene	9636.36	31000.00	63529.41	53600.00	159545.45	148888.88
Phenanthrene	45454.54	90000.00	168823.52	140666.66	448636.36	422777.77
Anthracene	26636.36	58000.00	94705.88	51000.00	124090.90	106666.66
Total LPAH	107590.90 T	296291.66 T	596470.58 T	485266.66 T	1461363.63 T	1240833.33 T
Fluoranthene	104090.90	132500.00	392352.94	138666.66	349545.45	323333.33
Pyrene	208636.36	165833.33	430588.23	194000.00	513636.36	351111.11
Benzo(a)anthracene	63636.36	56000.00	92941.17	32933.33	61818.18	50111.11
Chrysene	96818.18	107500.00	140588.23	56466.66	90000.00	58888.88
Total Benzofluoranthene	185909.09 T	161333.33 T	189529.41 T	91266.66 T	142363.63 T	102000.00 T
Benzo(a)pyrene	90909.09	71666.66	77058.82	38466.66	58181.81	39388.88
Indeno(1,2,3-cd)pyrene	50000.00	33416.66	34000.00	17066.66	24636.36	16277.77
Dibenz(a,h)anthracene	16363.63	9833.33	11529.41	4973.33	7636.36	4705.55
Benzo(g,h,i)perylene	44181.81	29000.00	31882.35	14866.66	23590.90	15666.66
Total HPAH	860545.45 T	767083.33 T	1400470.58 T	588706.66 T	1271409.09 T	961483.33 T
Total B(a)P equivalent	132210.45 T	102512.50 T	115494.70 T	55469.13 T	85181.81 T	58812.22 T
Dioxins and Furans (ng/kg)						
2378-TCDF	3.70	0.40 U	0.40 U	0.40 U	0.40 U	3.20
Total TCDF	34.00	0.40 U	6.70	2.50	1.50	15.00
2378-TCDD	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U
Total TCDD	16.00	3.50	21.00	12.00	5.80	51.00
12378-PeCDF	1.90 UI	1.90 U	2.00 U	2.00 U	1.90 U	2.00 U

A blank cell indicates analysis was not performed.

Table 4-8—Phase 2 Bioaccumulation Trawl Catch Results

Common Name	Scientific Name / Trawl Depth	FT2-ALKI-ES-FT-R1/R2 9/16/96 40 m	FT2-ALKI-ES-FT-R3 9/16/96 40 m	FT2-MAGL-ES-FT-R1 9/16/96 60 m	FT2-MAGL-ES-FT-R2 9/16/96 60 m	FT2-MAGL-ES-FT/WB-R2 9/16/96 60 m	FT2-WEST-ES-FT-R1 9/16/96 60 m	FT2-WEST-ES-WB-R2 (R1B) 9/17/96 40 m	FT2-WEST-ES-WB-R3 9/17/96 60 m	FT2-WEST-ES-WB/FT-R4 9/17/96 60 m	FT2-NRTH-ES-WB/FT-R1,R2, 9/17/96 60 m	FT2-WEST-ES-WB/FT-R5 9/17/96 60 m	FT2-NRTH-ES-WB/FT-R4,R5, 9/17/96 60 m	Total	Overall %
Finfish Species															
Pacific sanddab	*Citharichthys sordidus*	16	2	22	44	29	1	3	1	1		1		120	3.13%
Speckled sanddab	*Citharichthys stigmaeus*		11											11	0.29%
Pacific herring	*Clupea harengus pallasi*			1							31	1	5	38	0.99%
Roughback sculpin	*Chitonotus pugetensis*		12	6	5	2	1	2	1					29	0.76%
Shiner perch	*Cymatogaster aggregata*		1	1	6	2	1		29	7	69	10	31	157	4.09%
Striped sea perch	*Embiotoca lateralis*	1												1	0.03%
Rex sole	*Errex zachirus*			1	1		1		1		1		1	6	0.16%
Slender sole	*Eopsetta exilis*	10	5	4	17	11	18	2	18	21	15	15	30	166	4.33%
Whitspotted greenling	*Hexagrammos stelleri*										1			1	0.03%
Flathead sole	*Hippoglossoides elassodon*									3	4		8	15	0.39%
Ratfish	*Hydrolagus colliei*			1	3	1						1		6	0.16%
Pacific staghorn sculpin	*Leptocottus armatus*										1			1	0.03%
Snake prickleback	*Lumpenus sagitta*	1												1	0.03%
Blackbelly eelpout	*Lycodopsis pacificus*				1		32		16	39	38	29	46	201	5.24%
Pacific hake	*Merluccius productus*						13		67	98	28	75	47	328	8.55%
Pacific tomcod	*Microgadus proximus*	1	1	180	400	258	7		10	18	9	17	54	955	24.89%
Dover sole	*Microstomus pacificus*	2	1	1	4	3	1			3	1	2	4	22	0.57%
Sailfin sculpin	*Nautichthys oculofasciatus*			1	1									2	0.05%
Pygmy poacher	*Odontopyxis trispinosa*	2												2	0.05%
Sturgeon poacher	*Podothecus acipenserinus*	1												1	0.03%
Bluebarred prickleback	*Plectobranchus evides*						2			2				4	0.10%
Rock sole	*Pleuronectes bilineatus*	20	33	25	45	18	2	5	8	2	4	2	8	172	4.48%
English sole	*Pleuronectes vetulus*	437	425	190	193	104	11	15	13	23	35	16	44	1506	39.25%
Plainfin midshipman	*Porichthys notatus*	1	2	1	2		4			4	2	4	4	24	0.63%
Sand sole	*Psettichthys melanostictus*	2												2	0.05%
Brown rockfish	*Sebastes auriculatus*		2											2	0.05%
Copper rockfish	*Sebastes caurinus*			2	13	3		1						19	0.50%
Spiny dogfish	*Squalus acanthias*										1	1		2	0.05%

Table 4-8—Phase 2 Bioaccumulation Trawl Catch Results

Common Name	Scientific Name / Trawl Depth	FT2-ALKI-ES-FT-R1/R2 9/16/96 40 m	FT2-ALKI-ES-FT-R3 9/16/96 40 m	FT2-MAGL-ES-FT-R1 9/16/96 60 m	FT2-MAGL-ES-FT-R2 9/16/96 60 m	FT2-MAGL-ES-FT/WB-R2 9/16/96 60 m	FT2-WEST-ES-FT-R1 9/16/96 60 m	FT2-WEST-ES-WB-R2 (R1B) 9/17/96 40 m	FT2-WEST-ES-WB-R3 9/17/96 60 m	FT2-WEST-ES-WB/FT-R4 9/17/96 60 m	FT2-NRTH-ES-WB/FT-R1,R2 9/17/96 60 m	FT2-WEST-ES-WB/FT-R5 9/17/96 60 m	FT2-NRTH-ES-WB/FT-R4,R5 9/17/96 60 m	Total	Overall %
Walleye pollock	*Theragra chalcogramma*				3									3	0.08%
Slim sculpin	*Radulinus asprellus*							1						1	0.03%
Longnose skate	*Raja rhina*				1								2	3	0.08%
Pile perch	*Rhacochilus vacca*							2	1		1			4	0.10%
Northern ronquil	*Ronquilus jordani*	2		2	5	5								14	0.36%
Bluespotted poacher	*Xeneretmus triacanthus*			1	6	3			1	2	2		1	16	0.42%
Longspine combfish	*Zaniolepis latipinnis*											2		2	0.05%
	Total Fish Captured	496	495	439	750	439*	94	31	166	223	243	174	285	**Total Fish 3837**	**100%**
Invertebrate Species															
Crangon shrimp	*Crangon spp.*	8	5											13	0.88%
Alaskan pink shrimp	*Pandalus eous*									31		61	1	93	6.30%
Spot shrimp	*Pandalus platyceros*			2		4	413		150	120	298	128	144	1259	85.24%
Sea cucumber	*Cucumaria piperata*	10	6											16	1.08%
Sea cucumber	*Stichopus californicus*								1					1	0.07%
Blood star	*Henricia leviuscula*				2									2	0.14%
Sea sta	*Crossaster spp.*		1											1	0.07%
Sea star	*Evasterius troschelii*							1						1	0.07%
Sea star	*Hippasterius spp.*		1		8									9	0.61%
Sea star	*Luidia foliolata*			2	1				3			1	5	12	0.81%
Sun star	*Solaster dawsoni*			16	17	3			1					37	2.51%
Vermillion star	*Mediaster aequalis*	2	10		3				8	4		1		28	1.90%
Gastropod	*Ceratio steoma*			2										2	0.14%
Nudibranch	*Armina spp.*		1			1								2	0.14%
Tunicate	--								1					1	0.07%
	Total Invertebrate Catch	20	24	22	31	8	413	1	164	155	298	191	150	**1477**	**100%**

* One individual with tumor.

Table 4-7 - Surface Sediment Exposure Concentrations

Constituent	Station ID: / Sample ID: / Depth (cm bgs):	EB049 SD2-EB49-0000 0 to 10 cm	EB060 SD2-EB60-0000 0 to 10 cm	EB067 SD2-EB67-0000 0 to 10 cm	EB077 SD2-EB77-0000 0 to 10 cm	EB080 SD2-EB80-0000 0 to 10 cm	EB085 SD2-EB85-0000 0 to 10 cm
23478-PeCDF		6.00	1.90 U	2.00 U	2.00 U	1.90 U	2.00 U
Total PeCDF		97.00	34.00	4.50	20.00	5.90	19.00
12378-PeCDD		1.90 UI	1.90 U	2.00 U	2.00 U	1.90 U	2.00 U
Total PeCDD		7.90	1.90 U	9.30	2.00 U	1.90 U	25.00
123478-HxCDF		9.50	1.90 UE	2.00 UE	2.00 UE	1.90 UE	2.00 UE
123678-HxCDF		4.20	1.90 UE	2.00 U	2.00 U	1.90 U	2.00 U
234678-HxCDF		6.80	4.00	2.00 U	2.00 U	1.90 U	2.00 U
123789-HxCDF		6.80	3.60	2.00 U	2.00 U	1.90 U	2.00 U
Total HxCDF		240.00	58.00	21.00	28.00	4.80	16.00
123478-HxCDD		1.90 U	2.80	2.00 U	2.00 UI	1.90 U	2.00 U
123678-HxCDD		29.00	15.00	8.10	2.00 UI	3.40	9.10
123789-HxCDD		1.90 UI	5.50	2.00 U	2.00 U	1.90 U	4.10
Total HxCDD		360.00	290.00	86.00	110.00	43.00	150.00
1234678-HpCDF		64.00	58.00	38.00	77.00	11.00	40.00
1234789-HpCDF		10.00	1.90 UI	2.00 U	2.00 UI	1.90 U	3.90
Total HpCDF		460.00	240.00	160.00	270.00	47.00	190.00
1234678-HpCDD		610.00	580.00	220.00	220.00	89.00	290.00
Total HpCDD		2000.00	1900.00	660.00	690.00	370.00	950.00
OCDF		340.00	170.00	170.00	260.00	43.00	200.00
OCDD		5000.00	6200.00	2400.00	2100.00	850.00	3400.00
Total 2,3,7,8-TCDD(Equiv)		21.18 T	15.84 T	5.96 T	5.33 T	2.23 T	8.57 T
Dioxins and Furans - TOCN (ng/kg)							
Total 2,3,7,8-TCDD(Equiv)		962.72 T	1320.00 T	350.58 T	355.33 T	101.50 T	476.61 T

A blank cell indicates analysis was not performed.

Table 4-7 - Surface Sediment Exposure Concentrations

Station ID:	EB087	EB104	EB106
Sample ID:	SD2-EB87-0000	SD2-EB104-0000	SD2-EB106-0000
Constituent / Depth (cm bgs):	0 to 10 cm	0 to 10 cm	0 to 10 cm
Semi-Volatile Organic Compounds (ug/kg)			
2-Chloronaphthalene	19.40 U	19.20 U	16.30 U
2-Methylnaphthalene	7910.00	5770.00	148.00
Carbazole	3090.00	1450.00	108.00
Naphthalene, 1-methyl	4570.00	4270.00	167.00
Retene	635.00	401.00	115.00
Naphthalene	29600.00	24100.00	525.00
Acenaphthylene	411.00	238.00	108.00
Acenaphthene	7990.00	8740.00	405.00
Fluorene	9410.00	8880.00	460.00
Phenanthrene	24400.00	21200.00	1460.00
Anthracene	20200.00	9130.00	747.00
Total LPAH	92011.00 T	72288.00 T	3705.00 T
Fluoranthene	21800.00	19600.00	1910.00
Pyrene	25600.00	28200.00	2280.00
Benzo(a)anthracene	4730.00	2700.00	1010.00
Chrysene	6130.00	3740.00	1590.00
Benzo(b)fluoranthene	6480.00	3140.00	1960.00
Benzo(k)fluoranthene	2110.00	925.00	690.00
Total Benzofluoranthene	8590.00 T	4065.00 T	2650.00 T
Benzo(a)pyrene	3460.00	1550.00	1200.00
Indeno(1,2,3-cd)pyrene	1240.00	514.00	524.00
Dibenz(a,h)anthracene	398.00	174.00	155.00
Benzo(g,h,i)perylene	1030.00	471.00	446.00
Total HPAH	72978.00 T	61014.00 T	11765.00 T
Total B(a)P equivalent	5130.23 T	2372.39 T	1712.89 T

A blank cell indicates analysis was not performed.

Table 4-7 - Surface Sediment Exposure Concentrations

Constituent	Station ID:	EB087	EB104	EB106
	Sample ID:	SD2-EB87-0000	SD2-EB104-0000	SD2-EB106-0000
	Depth (cm bgs):	0 to 10 cm	0 to 10 cm	0 to 10 cm
Semi-Volatile Organic Compounds - TOCN (ug/kg)				
2-Methylnaphthalene		359545.45	262272.72	11384.61
Naphthalene		1345454.54	1095454.54	40384.61
Acenaphthylene		18681.81	10818.18	8307.69
Acenaphthene		363181.81	397272.72	31153.84
Fluorene		427727.27	403636.36	35384.61
Phenanthrene		1109090.90	963636.36	112307.69
Anthracene		918181.81	415000.00	57461.53
Total LPAH		4182318.18 T	3285818.18 T	285000.00 T
Fluoranthene		990909.09	890909.09	146923.07
Pyrene		1163636.36	1281818.18	175384.61
Benzo(a)anthracene		215000.00	122727.27	77692.30
Chrysene		278636.36	170000.00	122307.69
Total Benzofluoranthene		390454.54 T	184772.72 T	203846.15 T
Benzo(a)pyrene		157272.72	70454.54	92307.69
Indeno(1,2,3-cd)pyrene		56363.63	23363.63	40307.69
Dibenz(a,h)anthracene		18090.90	7909.09	11923.07
Benzo(g,h,i)perylene		46818.18	21409.09	34307.69
Total HPAH		3317181.81 T	2773363.63 T	905000.00 T
Total B(a)P equivalent		233192.27 T	107835.90 T	131760.76 T
Dioxins and Furans (ng/kg)				
2378-TCDF		7.60	2.60	0.40 U
Total TCDF		100.00	19.00	1.30
2378-TCDD		0.40 U	0.40 U	0.40 U
Total TCDD		79.00	22.00	1.40
12378-PeCDF		3.30	2.00 U	2.00 U

A blank cell indicates analysis was not performed.

Table 4-7 - Surface Sediment Exposure Concentrations

Station ID:	EB087	EB104	EB106
Sample ID:	SD2-EB87-0000	SD2-EB104-0000	SD2-EB106-0000
Constituent Depth (cm bgs):	0 to 10 cm	0 to 10 cm	0 to 10 cm
23478-PeCDF	6.30	2.00 U	2.00 U
Total PeCDF	73.00	20.00	30.00
12378-PeCDD	1.90 UI	2.00 U	2.00 U
Total PeCDD	48.00	8.40	2.00 U
123478-HxCDF	1.90 UE	2.00 UE	2.00 UE
123678-HxCDF	4.10	2.00 U	2.00 UE
234678-HxCDF	5.40	2.00 U	3.40
123789-HxCDF	4.00	2.00 U	3.30
Total HxCDF	68.00	19.00	41.00
123478-HxCDD	1.90 UI	2.00 UI	2.00 U
123678-HxCDD	25.00	10.00	14.00
123789-HxCDD	14.00	2.00 UI	5.10
Total HxCDD	330.00	170.00	240.00
1234678-HpCDF	140.00	60.00	64.00
1234789-HpCDF	9.80	2.00 UI	2.00 UI
Total HpCDF	560.00	260.00	280.00
1234678-HpCDD	740.00	380.00	560.00
Total HpCDD	2500.00	1300.00	1800.00
OCDF	430.00	240.00	230.00
OCDD	7500.00	4000.00	6000.00
Total 2,3,7,8-TCDD(Equiv)	26.15 T	9.90 T	15.05 T
Dioxins and Furans - TOCN (ng/kg)			
Total 2,3,7,8-TCDD(Equiv)	1188.77 T	450.00 T	1157.69 T

A blank cell indicates analysis was not performed.

Table 4-9—Transect Averages for Whole Body English Sole Tissues

Transect/Station ID	Wet Weight TCDD (ng/kg)	Lipid Normalized TCDD (ng/kg)
NORTH-ES-WB-R1	0.12	5.45
NORTH-ES-WB-R2	0.04	1.45
NORTH-ES-WB-R3	0.02	0.81
WEST-ES-WB-R2	3.03	144.52
WEST-ES-WB-R4	0.65	16.42
WEST-ES-WB-R5	0.12	3.33
MSU Average	*0.663*	*28.67*

Note: Whole body fish tissues are based on composites of several fish from within each trawl. MSU averages are based on the average of concentrations from all the trawls. Concentrations were lipid-normalized by dividing each individual trawl concentration by the percent lipid measured for that trawl.

Table 4-10—Egg Tissue Concentration Data

Transect/Station ID	Whole Body Fish Tissues TCDD (ng/kg-ww)	Egg Tissues (ww) TCDD (ng/kg-ww)
NORTH-ES-WB-R1	0.12	0.06
NORTH-ES-WB-R2	0.04	0.02
NORTH-ES-WB-R3	0.02	0.01
WEST-ES-WB-R2	3.03	1.52
WEST-ES-WB-R4	0.65	0.33
WEST-ES-WB-R5	0.12	0.06
MSU Average	*0.663*	*0.33*

Note: Whole body fish tissues are based on wet weight concentrations composited within each of six stations. MSU averages are based on the average of all the trawls. Egg tissue concentrations are presented as wet weight and are based on TCDD maternal transfer rate of 50 percent. TCDD is expressed as congener-specific total 2,3,7,8-TCDD equivalents in units of ng/kg.

SECTION 5

TOXICITY ASSESSMENT

The toxicity assessment identifies the values that will be used to characterize the magnitude of adverse effects associated with site-specific estimates of exposure of receptors to COPCs for each effect endpoint evaluated. The information presented below was used to evaluate whether human health or ecological impacts would occur within the MSU for current conditions as well as under different cleanup scenarios. For this site, the toxicity assessment includes identification of EPA-derived toxicity values, effects data reported in the literature for similar receptors exposed to the MSU COPCs, effects-based screening levels, and measurements of actual deleterious effects in benthic infauna.

5.1 HUMAN HEALTH TOXICITY ASSESSMENT

The human health component of the toxicity assessment presents the available toxicity data used to determine and quantify the relationship between the level of exposure (dose) to a COPC and the increased likelihood of adverse effects. Evaluation of toxic effects in Superfund risk assessments relies on EPA-promulgated toxicity criteria. Carcinogenic risks are evaluated using cancer slope (or potency) factors (CSFs), and noncancer impacts are evaluated using reference doses (RfDs).

CSFs are used to estimate the probability that a person would develop cancer given the chemical potency of a site-specific exposure dose. This chemical-induced risk calculated based on the CSF is in addition to the risk of developing cancer due to other causes over a lifetime. Consequently, the risk estimates generated in risk assessments are frequently referred to as incremental or excess lifetime cancer risks.

RfDs represent a daily contaminant intake below which no adverse human health effects are expected to occur. To evaluate noncarcinogenic health effects, the human health impact of contaminants is approximated using a hazard quotient (HQ). Hazard quotients are calculated by comparing the estimates of site-specific human exposure doses with RfDs.

5.1.1 Toxicity Values

5.1.1.1 Cancer Slope Factors

Contaminant-specific CSFs are developed by EPA for specific exposure routes (e.g., oral). The likelihood that an agent is a human carcinogen is evaluated using EPA's weight-of-evidence classification (EPA 1989a). The available data derived from human and animal studies are reviewed and characterized as sufficient, limited, inadequate, no data, or evidence of no effect.

Based on the extent to which a contaminant has been demonstrated to be a carcinogen in experimental animals and/or humans, the contaminant is assigned the following weight-of-evidence classification:

Classification	Description
A	human carcinogen
B1	probable human carcinogen—limited human data available
B2	probable human carcinogen—sufficient evidence of carcinogenicity in animals and inadequate or no evidence in humans
C	possible human carcinogen
D	not classifiable as to human carcinogenicity
E	no evidence of carcinogenicity in humans

EPA derives slope factors for those contaminants with a weight of carcinogenicity evidence of A through C from studies that demonstrate the dose-response relationship of a substance's carcinogenic effects. The slope factor is usually the upper 95^{th} percent confidence limit of the slope of the dose-response curve, and is expressed as the inverse of the daily dose per unit body weight ($[mg/kg\text{-}day]^{-1}$). Most slope factors currently approved by EPA were generated using the linear multistage model. This model assumes that any dose of carcinogen, no matter how small, is associated with some quantifiable risk (i.e., there is no threshold for carcinogenic effects) (EPA 1989a).

Of the human health COPCs detected in fish and shellfish, dioxins, and some PAHs are considered to be carcinogenic. The following hierarchical approach was used to select slope factors to evaluate the human cancer potential for COPCs in this risk assessment.

- The IRIS computer database (EPA 1997) was searched for each COPC for human health. This is the preferred source of toxicity values because these values have been verified by EPA following extensive review processes.
- The Health Effects Assessment Summary Tables (HEAST) (EPA 1995a) were consulted for each contaminant if a toxicity value was not available on IRIS. These values have been established by EPA's National Center for Environmental Assessment specifically for use in risk assessments under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA).

- Extrapolated and surrogate toxicity values were used for some COPCs (e.g., some PAHs) without available IRIS or HEAST toxicity values but for which adequate toxicity information was available to draw such correlations.

- COPCs without available toxicity values were identified and the potential effect on risk estimates of not having values for these COPCs is discussed qualitatively in the uncertainty analysis.

The potential cancer risks posed by selected PAHs were evaluated using the toxicity equivalency factor approach. First introduced by EPA Region IV (1992b), this approach assigned toxicity potency factors to carcinogenic PAHs relative to the toxicity of benzo(a)pyrene (B[a]P), a carcinogenic PAH. A total B(a)P equivalent concentration is derived by multiplying each individual carcinogenic PAH concentration by its equivalency factor and summing the results. The toxicity equivalency factors used in the risk assessment are shown in **Table 5-1**.

Carcinogenic PAH concentrations were combined and referred to as total B(a)P equivalents. Carcinogenicity from B(a)P equivalents was evaluated using the CSF for benzo(a)pyrene.

Dioxin and furan compounds were adjusted based on a toxicity equivalency factor approach (as described in the Phase 2 Tech Memo [WESTON 1997a]) similar to the approach for carcinogenic PAHs. A CSF for dioxin was found in the Health Effects Summary Tables (EPA 1995a). The cancer slope factors proposed for use in the risk assessment are presented in **Table 5-2**.

5.1.1.2 Noncancer Reference Doses

As with CSFs, chemical-specific RfDs are developed for individual exposure routes (e.g., oral) for non-cancer health-effects. In general, RfDs are derived from a no-observed-adverse-effect level (NOAEL) or a lowest-observed-adverse-effect level (LOAEL) in humans or the most sensitive species of animal tested (although factors such as the quality of the data set may influence the study chosen to derive the RfD). Because the NOAEL represents an experimentally determined threshold level, these data are preferred for deriving an RfD. However, not all data sets are adequate to derive a NOAEL, in which case the RfD is derived from the LOAEL. NOAEL or LOAEL data for each chemical are then adjusted to represent an estimated daily dose in mg/kg-day, which is then used as the RfD for that chemical. In deriving an RfD, EPA divides the NOAEL or LOAEL by a series of uncertainty factors ranging in value from 1 to 10 to account for each of the following sources of uncertainty that may apply to the toxicity data:

- Use of a LOAEL where data are inadequate to derive a NOAEL

- Use of data from experimental animals to evaluate effects in human populations

- Use of data derived from the general population to evaluate populations that may have special sensitivities (e.g., immunological impairments and age-related developmental vulnerabilities)

Additionally, a modifying factor of 1 to 10 may be incorporated in the derivation of an RfD to reflect additional uncertainties in the critical study or in the entire database. EPA also assigns a qualitative level of confidence (i.e., low, medium, or high) to the study used to derive the toxicity value, to the overall database, and to the RfD. The relative degree of uncertainty associated with the RfDs and the level of confidence that EPA assigns to the data and the toxicity value are considered when evaluating the quantitative results of the risk assessment.

As with CSFs, RfDs were searched for primarily on IRIS (EPA 1997). An RfD was identified for one noncarcinogenic PAH. No RfD was available for dioxin, for benzo(a)pyrene or its equivalents, or for benzo(g,h,i)perylene or phenanthrene. The reference doses proposed for use in this risk assessment are presented in **Table 5-3**.

5.1.2 Toxicity Assessment Uncertainties

As with the exposure assessment, there are several uncertainties associated with the toxicity assessment. These uncertainties are identified in the following paragraphs.

- *Application of equivalency factors.* The equivalency factor approach used to evaluate effects from carcinogenic PAHs and dioxin compounds may lead to an over- or under-estimation of risks from individually contributing contaminants, although this approach was designed to provide a more accurate representation of toxicity.

- *Unavailable toxicity factors.* No toxicity criteria were available to assess risks from benzo(g,h,i)perylene and phenanthrene. Therefore, total non-cancer impacts from COPCs at the site may be underestimated.

- *Uncertainty in derivation of individual toxicity factors.* A variety of contributing factors may result in uncertainties associated directly with the toxicity values, particularly those factors associated with the derivation of the individual values:

  (1) Use of dose-response information from effects observed at high doses to predict the adverse health effects that may occur from exposure to the low levels expected from human contact with the agent in the environment.

  (2) Use of dose-response information from short-term exposure studies to predict the effects of long-term exposures, and vice versa.

  (3) Use of dose-response information from animal studies to predict effects in humans.

(4) Use of dose-response information from homogeneous animal populations to predict the effects likely to be observed in a general population consisting of individuals with a wide range of sensitivities.

(5) The assumption of a linear, no-threshold cancer relationship between COPCs and environmental doses.

Although uncertainty factors are applied to account for many of these factors, they may still lead to over- or underestimation of risks.

- *Weight of evidence factors.* Dioxins (based on 2,3,7,8-TCDD) and the carcinogenic PAHs (based on evidence for benzo(a)pyrene) are classified as B2, or probable human carcinogens. While there is no evidence of carcinogenicity in humans, there is sufficient evidence of carcinogenicity in animals. There are a number of uncertainties regarding evidence of carcinogenicity based on animal tests. One is the use of maximum tolerated doses that cause cellular damage, which increases the rate of cell growth during repair processes. High rates of cell growth tend to increase the potential for carcinogenic effects as a result of the exposure. Another source of uncertainty is the assumption that all chemicals that are carcinogenic in animals are also carcinogenic in humans. For chemicals classified as Group B2, lack of evidence of carcinogenicity in human results in considerable uncertainty in the carcinogenic risk estimates.

These uncertainty factors are discussed more specifically with regard to actual risk estimates presented in the risk characterization (**Section 6**).

5.2 ECOLOGICAL TOXICITY ASSESSMENT

The ecological component of the toxicity assessment presents the criteria used to evaluate potential toxicity of COPCs to ecological receptors at the site. Ecological toxicity is evaluated based on individual chemical effects data as well as observed toxic responses to media contaminated by multiple chemicals. Each set of toxicity criteria can only represent potential toxicity to a given set of ecological receptors (e.g., benthic organisms). Therefore, several different criteria were used to evaluate potential toxicity to a range of ecological receptors at the site.

Effects-based criteria were used to evaluate toxicity to benthic organisms exposed to contaminated sediment. These criteria are chemical-specific threshold concentrations above which adverse ecological impacts to the benthic community would be expected. Site-specific toxicological impacts from combined chemical contamination were also evaluated by comparing growth and mortality responses of organisms exposed to sediment collected from the site to responses of organisms exposed to control sediment. Site-specific toxicological impacts from combined chemical contamination were also evaluated by comparing site-collected benthic infaunal community data to similar samples collected from reference areas. Community structure data included measures of abundance and diversity. Chemical-specific toxicity evaluations were also conducted for measured concentrations of COPCs in fish collected from the site and in clams grown in site-collected sediment. Estimates of fish egg concentrations were made based on a simple maternal transfer model. Toxicity to fish and fish eggs were evaluated using literature-based effects concentrations of chemicals in tissues and background concentrations of chemicals in clam tissue. Chemical-specific background concentrations are not effects-based thresholds, but they provide evidence to compare accumulation of chemicals in organisms living in contaminated sediment to those living in relatively uncontaminated sediment and may indicate a greater likelihood of deleterious effects occurring.

5.2.1 Sediment

Effects-based criteria that were used in the evaluation of the MSU sediment data were based on the SMS chemical criteria, as well as AET screening values in cases where TOC-normalization of sediment chemical concentrations was not appropriate. Exceedances of SMS criteria or AET screening values were represented by a ratio (hazard quotient) of site data over the criterion for each chemical.

5.2.2 Laboratory Bioassays

Laboratory bioassays measuring mortality for the amphipod *Ampelisca abdita*, mortality and abnormal embryo development for the echinoderm *Dendraster excentricus*, and mortality and growth rates for the clam *Macoma nasuta* were conducted using surface sediment samples collected from the nine MSU stations listed in **Section 4.2.1** (Ecological Exposure Assessment) and two Elliott Bay background stations (offshore of Magnolia [BK01] and Alki [BK04], see RI **Figure 1-6**). The amphipod and echinoderm bioassays were also conducted using surface sediment collected from a Puget Sound background location in Carr Inlet.

The laboratory bioassays were conducted as part of the site investigations to directly measure sediment toxicity. Biological criteria for determining whether invertebrate species are impacted have been established as part of the SMS, and include SQS and CSL effects criteria. The SQS and CSLs for biological effects were based on results of marine sediment tests (i.e., amphipod mortality, larval abnormal development, alterations in benthic community structure, and reductions in bacterial luminescence [Microtox™]). In accordance with the SMS biological criteria including recent modifications, toxicity for this risk assessment was defined as a statistically significant increase in mortality and developmental abnormality, or decrease in growth, for sensitive and early life stage invertebrates exposed to site sediments, as compared with invertebrates exposed to sediment from selected background locations used as reference samples. As discussed in the Phase 2 Technical Memorandum (WESTON 1997a), control data were substituted for reference data, due to reference area performance failures for samples collected from the Elliott Bay background and Carr Inlet reference stations.

The results of the toxicity tests were also statistically compared with sediment chemical and conventional data to evaluate whether variations in the observed biological responses were associated with variations in concentrations of contaminants or conventionals in the surface sediments tested. The statistical comparisons were based on Pearson correlation analyses, which are described in detail in **Attachment K.4**. Correlation results were considered to be ecologically significant when a strong degree of association was observed (i.e., when the correlation coefficient "r" had a value greater than or equal to 0.7).

5.2.2.1 Amphipods

The amphipod bioassay measured mortality in adult organisms following a 10-day exposure to sediment collected from the MSU and Elliott Bay background stations and a Carr Inlet reference station, as well as laboratory control sediment. For the purposes of the toxicity assessment, the SQS biological effects criterion was selected for use in estimating potential sediment toxicity to benthic communities inhabiting the MSU. Comparisons with the CSL biological effects criterion were also conducted as part of the toxicity assessment to demonstrate magnitude of potential impact. Specific numerical and statistical criteria are as follows:

- Test sediment mortalities greater than 25 percent (on an absolute basis) and significantly ($P \leq 0.05$) greater than reference mortality were considered indicative of potential adverse effects.
- The CSL criterion was exceeded when amphipod mortality in the test sediment exceeded 30 percent relative to (i.e., above) reference and was significantly ($P \leq 0.05$) higher than reference.

As previously discussed, both tests were modified by substituting control for reference mortality, because of reference area performance failures.

To evaluate whether mortalities of amphipods exposed to the MSU were significantly higher than control mortality responses, statistical evaluations of the amphipod bioassay data were conducted using parametric pair-wise comparisons (i.e., independent t-tests) and multiple-comparison analysis of variance (ANOVA) techniques, which are described in detail in **Attachment K.4**.

5.2.2.2 Echinoderm Larvae

The echinoderm bioassay measured mortality and abnormal development in embryos following a 96-hour exposure to sediment collected from the MSU and Elliott Bay background stations and a Carr Inlet reference station, as well as laboratory control seawater. Similar to the approach described above for assessing the amphipod bioassay data, the SQS biological effects criterion for the larval test was selected for use in estimating toxicity to benthic communities inhabiting the MSU, and comparisons with the CSL biological effects criterion were used in the assessment of overall magnitude of impact. These criteria are designated as follows:

- SQS: Test sediment effective mortality (i.e., mortality plus abnormal development) greater than 15 percent relative to reference sediment effective mortality and significantly ($P \leq 0.10$; Ecology 1996) higher than reference effective mortality.

- CSL: Test sediment effective mortality greater than 30 percent relative to reference sediment effective mortality and significantly ($P \leq 0.10$) higher than reference effective mortality.

As previously discussed, both tests were modified by substituting control for reference mortality.

To evaluate whether mortality and abnormality in echinoderm embryos exposed to the MSU was significantly higher than control mortality and abnormality responses, statistical evaluations of the echinoderm larval bioassay data were conducted using non-parametric pair-wise comparisons (i.e., Mann-Whitney U tests) and Kruskal-Wallis multiple-comparison ANOVA techniques, which are described in detail in **Attachment K.4**. Non-parametric techniques were required because the variance term for the controls was equal to zero (control effective mortality, by default, is set at zero), precluding the use of parametric tests.

5.2.3 Clams

The clam bioassay measured three endpoints: mortality in *Macoma nasuta* exposed for 28 days to MSU, Elliott Bay background, and control sediments; growth rates of the surviving individual organisms, based on changes in weight (expressed as milligrams per individual per day, or mg/ind/day); and accumulation of selected chemicals in whole-body tissues of surviving organisms. The methods for conducting evaluations of the tissue data are described in below in **Section 5.2.5**. Biological criteria for determining whether clams are impacted based on elevated mortalities or depressed growth rates relative to reference have not been established in the SMS. Therefore, for the purposes of assessing toxicity, the biological criteria used for assessing the clam data were modeled after the SMS criteria for evaluating amphipod mortality and polychaete growth rates, as discussed below.

The probable effects criterion for assessing the clam mortality data was based on the SMS SQS biological criterion for amphipod mortality, and was established as follows:

- Test sediment clam mortalities greater than 25 percent (on an absolute basis) and significantly ($P \leq 0.05$) greater than control mortality were considered indicative of potential adverse effects.

A criterion similar to the SMS SQS biological criterion for assessing juvenile polychaete growth rates was initially proposed for use in evaluating the clam growth data. Specifically, growth rates less than or equal to 70 percent of control growth rates and statistically significantly ($P \leq 0.05$) different from control were proposed as an indicator of adverse biological effects. This criterion was based on the premise that the test clams, particularly those exposed to control sediments, would exhibit an overall increase in weight. However, the control clams exhibited a loss in weight over the course of the 28-day testing period, resulting in a "negative" growth rate. Subsequently, the probable effects criterion was adjusted as follows:

- An average weight loss in clams exposed to PSR sediments of 30 percent (or more) greater than that exhibited by clams exposed to control sediments and statistically significantly ($P \leq 0.05$) different from control was considered indicative of deleterious effects.

Pair-wise and multiple-comparison statistical methods similar to those used to evaluate the amphipod and echinoderm data were initially proposed for assessing the statistical relationships between control and test responses for the clam bioassay. However, review of the clam mortality and growth rate data indicated that test responses did not exceed their respective numerical criteria; therefore, statistical testing of MSU versus control responses was not required.

5.2.4 Benthic Infauna

Benthic infauna were collected from nine MSU and two Elliott Bay background stations (BK01 and BK04) at which surface sediments were also collected for laboratory toxicity testing. The benthic sampling was conducted to provide an *in situ* measure of potential toxicity associated with chronic exposure to moderately contaminated sediments.

Impacts to benthic communities were evaluated using a number of community metrics and data analysis techniques, including measures of abundance (major taxonomic group, total, and dominant taxa), richness (total and major taxonomic group), and dominance (based on Swartz's Dominance Index [SDI]), as well as community structure characteristics (as determined by the Bray Curtis similarity index) and relative abundance and richness of pollution-tolerant and pollution-sensitive taxa. Details regarding the methods used to derive the numerical endpoints are provided in **Attachment K.4**.

Exceedances of the following toxicity criteria were used in the preponderance of evidence approach to define impacted benthic communities:

- Major taxonomic group (crustaceans, molluscs, polychaetes) abundances—Mean abundance of any one group reduced to less than 50 percent of the average reference site value and statistically significantly ($P \leq 0.05$) lower than reference (per the SMS SQS biological criterion).

- Total abundance, total richness, and major taxonomic group abundance and richness—Mean values statistically significantly ($P \leq 0.10$) less than mean reference values.

- Polychaete abundance—Mean values statistically significantly ($P \leq 0.10$) higher than mean reference values (i.e., enhanced relative to reference).

- SDI—Values less than or approximating 5.0.

- Community structure analyses—Lack of similarity of MSU station groups (as defined by cluster analysis) with reference areas or each other where habitat characteristics suggested similarities would have existed in the absence of contaminant effects.

- Dominance of taxa considered to be tolerant of contaminated or organically-enriched sediment, particularly capitelleid, spionid and lumbrinerid polychaetes, ostracods, and clams (*Macoma* spp., *Axinopsida serricata*) based on enhanced abundance and richness relative to reference.

- Absence of sensitive taxa, particularly gammarid or phoxocephalid amphipods, based on reduced abundance and richness relative to reference.

Reference data for SMS were represented by a station selected from the Elliott Bay background areas and generally matching site characteristics. Because habitat characteristics can affect benthic community structure, sediment grain size data for each of the two Elliott Bay background stations were reviewed prior to conducting comparisons with any of the above criteria. Substrates at the Alki reference station (BK04) were characterized as silty (21 percent)-sands (76 percent). Similarly, the Magnolia reference station (BK01) was represented by silty (9 percent)-sand (85 percent), but with a higher relative proportion of medium to coarse sands (43 percent) than the other background and MSU stations. Because the Alki background sampling location represented a closer grain size match to the MSU stations than the Magnolia station, the Alki reference station was selected for use in all of the statistical evaluations requiring direct comparisons with reference. The relatively high abundance and diversity of the community at the Alki reference station further supported its use as a reference station for comparison to the site. Community composition, including a higher proportion of potentially sensitive taxa, also suggested this station was appropriate for use as a reference. For completeness, community metrics and community structure characteristics were derived for the Magnolia station and included in the data presentations, but the analysis of exceedances relative to reference was not based on comparisons with this background area.

The statistical comparisons among the MSU stations and the benthic community reference station were based on those parametric pair-wise and multiple-comparison statistical tests previously described in **Section 5.2.2.1** for the analysis of the amphipod bioassay data and detailed in **Attachment K.4**. In addition, ANOVAs with Tukey's *a posteriori* test (see **Attachment K.4**) were conducted using MSU stations only (the background station was excluded from the matrix) to determine whether significant differences occurred for any of the possible site-related station pairs, which could potentially indicate differing relative degrees of risk to MSU benthic receptors.

5.2.5 Clam Bioaccumulation

The laboratory clam bioassay conducted in support of the risk assessment included the measurement of clam COPC concentrations in unpurged whole body tissues following a 28-day exposure period to sediment collected from the MSU and Elliott Bay background areas. A literature search was conducted to locate any available information on sublethal effects associated with specific body burdens; however, no relevant sources of information were found for the contaminants of concern. In lieu of conducting comparisons with effects-based data, the concentrations of chemicals measured in these whole body clam tissues were compared with average chemical concentrations measured in whole body tissues of clams exposed to Elliott Bay background sediment (BK01 and BK04). This comparison does not serve as an indicator of sediment toxicity to benthic organisms, but provides an indicator of the degree to which benthic organisms exposed to sediments from the site may be bioaccumulating contaminants of concern relative to receptors located in other areas of Elliott Bay. In addition, it is assumed that greater degrees of exposure have a higher potential to result in adverse effects.

The concentrations of bioaccumulative contaminants of concern measured in MSU and background area tissues were also statistically compared with co-located surface sediment concentrations of the same contaminants to evaluate the degree of association between tissue and sediment chemistry. The statistical comparisons were based on Pearson correlation analyses, which are described in detail in **Attachment K.4**.

5.2.6 Fish Bioaccumulation

The approach for evaluating adverse effects to bottom fish from exposure to bioaccumulative contaminants in offshore sediment focused on two specific endpoints: (1) adverse effects to juvenile and/or adult fish, and (2) adverse effects to egg and/or fry. Both endpoints are designed to assess the viability of the bottom fish community in the presence of potentially elevated offshore contamination (i.e., TCDD) by examining effects at two separate and distinct lifestages in bottom fish. The toxicity data used are based on literature-derived fish and egg tissue concentrations.

Some of the data suggest that early life stages of fish are substantially more sensitive than older fish (EPA, 1993a). Other data suggest that early life stages are unlikely to be the most sensitive endpoint given the toxicological nature of the contaminants and long-term post exposure mortality often observed (Cook, 1995). Because of conflicting opinions as to which lifestage is the most sensitive to long-term bioaccumulative effects from TCDD, both were included.

Literature values chosen as toxicity benchmarks (i.e., values over which toxic effects may occur) were either no-observed adverse effects levels (NOAELs) or lowest observed adverse effect levels (LOAELs). In the selection of a toxicity benchmark value, preference was given to a NOAEL over a LOAEL. Where multiple NOAELs were found, the highest NOAEL was selected. When a NOAEL was not available, the lowest LOAEL was selected. Studies reporting

NOAELs and LOAELs based on toxic endpoints such as increased enzyme activity or impaired immunological function were not considered because these endpoints cannot be directly tied to population effects.

In some instances the lowest reported LOAEL was lower than the highest reported NOAEL (i.e., in some studies, adverse effects were seen at concentrations below levels of concern in other studies). Use of the NOAEL in these instances creates uncertainty in risk estimates, as does use of the highest (as opposed to the lowest) NOAEL. These uncertainties and their associated effect on risk estimates is presented in **Section 7.4.3**.

The following sections describe the literature reviewed for identification of toxicity values, present brief toxicity profiles for the contaminants evaluated, and identify the toxicity values used in risk estimates.

5.2.6.1 TCDD

A summary of effects concentrations for TCDD in fish as documented from the scientific literature is provided in **Table 5-4**. Toxicity information for several species of freshwater fish as well as two species of marine fish were available. More data were available for freshwater species (i.e., rainbow and lake trout) versus marine species (little skate and winter flounder). However, only adverse effects to short-term exposure were presented for marine species.

All of the effects data are reported as wet weight TCDD (as 2,3,7,8-TCDD equivalents) concentrations in eggs or fish tissue. Some concentrations were based on model calculations rather than actual measurements, including no-observed adverse effect level (NOAEL) and lowest-observed adverse effect level (LOAEL) data.

5.2.6.1.1 Toxicity Profile for TCDD in Fishes

TCDD represents the prototypical compound for a variety of structurally similar contaminants of environmental concern that appear to act via the same mode of action, which include several non- and mono-ortho-substituted PCBs. The initial step by which TCDD is thought to exert its toxicity is through binding to the Ah receptor within cells. Internally produced ligands for the Ah receptor have not yet been identified, and some have speculated that the function of the Ah receptor may be regulated by externally produced materials (EPA 1993a).

After initial binding, the ligand-receptor complex is translocated to the nucleus of the cell where it becomes associated with DNA thereby causing alteration of one or more target genes. The subsequent suite of physiological effects observed are somewhat species-specific but remarkably consistent across vertebrate phylogenetic lines. The presence of the Ah receptor in fishes, and lack of the receptor in aquatic invertebrates, is consistent with the relative sensitivity of the two groups of species to TCDD and structurally-similar compounds. However, the Ah receptor has gone undetected in some species of primitive fishes (e.g., hagfish, lamprey), thus raising questions as to their sensitivity to TCDD toxicity. Exposure to fishes results in effects similar to those seen in mammals, such as mortality, weight loss, reproductive impairment, histopathologic alterations, and possible immunosuppression (EPA 1993a).

5.2.6.1.2 TCDD Effects Levels Used in Risk Estimates

The TCDD effects level used to assess potential risk to fish eggs/fry was 34 ng TCDD/kg (wet weight). This value represents the highest reported NOAEL for lake trout fry.

The TCDD effects level used to assess potential risk to adult/juvenile fish was 314 ng TCDD/kg (wet weight). This value represents the highest reported NOAEL for juvenile rainbow trout.

It is important to note that neither of these levels incorporate uncertainty factors that address issues such as greater sensitivity of untested fish species or the potential greater sensitivity of other study endpoints not chosen. It is also noted here that the effect level (i.e., the highest reported NOAEL) used for adult juvenile fish (314 ng TCDD/kg-ww) is slightly higher than the lowest reported LOAEL (300 ng TCDD/kg-ww) for adult/juvenile fish. In addition, the lowest reported NOAEL for adult/juvenile fish was 21 ng TCDD/kg-ww, which is more than an order of magnitude lower than the highest NOAEL used in risk estimates. The effect on risk estimates of using these alternate values is discussed in **Section 7.4.3**.

SECTION 5 TABLES

Table 5-1—Equivalency Factors Used in Calculating Total Carcinogenic PAHs

Contaminant	TEF
Benzo(a)pyrene	1.0
Benzo(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.1
Chrysene	0.001
Dibenz(a,h)anthracene	1.0
Indeno(1,2,3-cd)pyrene	0.1

Table 5-2—Cancer Slope Factors

Analyte	Weight of Evidence[1]	Carcinogenicity Basis	Species/Type of Cancer	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Oral Slope Factor Source
Polycyclic Aromatic Hydrocarbons (PAHs)					
Benzo(a)pyrene	B2	Human data specifically linking B(a)P to a carcinogenic effect are lacking. There are, however, multiple animal studies in many species demonstrating B(a)P to be carcinogenic following administration by numerous routes. B(a)P has produced positive results in numerous genotoxicity assays.	Mice/Forestomach, squamous cell papillomas and carcinomas.	7.3	IRIS on-line 1997
Benzo(g,h,i)perylene	D	No human data and inadequate data from animal bioassays	NA	NA	NA
Phenanthrene	D	No human data and inadequate data from animal bioassays	NA	NA	NA
Pyrene	D	No human data and inadequate data from animal bioassays	NA	NA	NA
Dioxins/Furans					
2,3,7,8-TCDD	B2	Liver, lung, palate and nasal tumors in rats. No human data, but animal data supportive of human carcinogenicity.	Rat tumors	1.56E+5	HEAST

NA = Not applicable

[1] See Section 5.1.1.1 for an explanation of the EPA weight-of-evidence classification scheme.

Table 5-3—Reference Doses for Noncancer Health Effects

Analyte	Oral RfD (mg/kg-day)	Species	Basis	Endpoint/Critical Effect	Uncertainty Factor	Modifying Factor	Confidence in Study	Confidence in Database	Confidence in Value	Source
Polycyclic Aromatic Hydrocarbons (PAHs)										
Benzo(a)pyrene										No value in IRIS on-line 1997 or HEAST, 1995
Benzo(g,h,i)perylene										No value in IRIS on-line 1997 or HEAST, 1995
Phenanthrene										No value in IRIS on-line 1997 or HEAST, 1995
Pyrene	0.03	Mice	Subchronic Oral Study	Kidney effects (renal tubular pathology, decrease kidney weights)	3000	None	Medium	Low	Low	IRIS on-line 1997
Dioxins/Furans										
2,3,7,8-TCDD										No value in IRIS on-line 1997 or HEAST, 1995

Table 5-4—Summary of Toxic Effects of TCDD to Fish[a]

Test Species	Lifestage	Test Method	Organism Concentration (ng/Kg)[b]	Duration		Effect	Reference
				Exposure	Observation		
Rainbow Trout (*Oncorhynchus mykiss*)	Egg to swim-up fry	Egg (injection)	230 (in eggs)	Single injection	Fertilized egg to swim-up fry	LR50 (sac fry)[c]	Walker and Peterson, 1991
	Egg to swim-up fry	Egg (injection)	240 (in eggs)	Single injection	Fertilized egg to swim-up fry	LR50 (sac fry)[c]	Walker and Peterson, 1991
	Egg to swim-up fry	Egg (injection)	374 (in eggs)	Single injection	Fertilized egg to swim-up fry	LR50 (sac fry)[c]	Walker and Peterson, 1991
	Egg to swim-up fry	Egg (injection)	488 (in eggs)	Single injection	Fertilized egg to swim-up fry	LR50 (sac fry)[c]	Walker and Peterson, 1991
	Egg to swim-up fry	Egg (injection)	421 (in eggs)	Single injection	>48-h to post swim-up fry	LR50 (sac fry)[c]	Walker et al., 1992
	Egg to swim-up fry	Water (renewal)	279 (in eggs)	Single injection	>48-h to post swim-up fry	Significant mortality in sac fry	Walker et al., 1992
	Egg to swim-up fry	Water (renewal)	439 (in eggs)	Single injection	>48-h to post swim-up fry	LR50 (sac fry)[c]	Walker et al., 1992
	Swim-up fry	Water (flow-thru)	3,220	28-day	28-day	95% mortality	Mehrle et al., 1988
	Swim-up fry	Water (flow-thru)	21[d]	28-day	28-day	NOAEL[e]	Mehrle et al., 1988
	Swim-up fry	Water (flow-thru)	765[d]	28-day	28-day	LOAEL[f] (45% mortality)	Mehrle et al., 1988
	Fingerling	i.p. injection	5,000[g]	Single injection	20-d	20% mortality	Spitsbergen et al., 1988a
	Fingerling	i.p. injection	5,000[g]	Single injection	11 to 12-wk	20% mortality, increased liver weight	van der Weiden et al., 1990
	Fingerling	i.p. injection	10,000[g]	Single injection	80-d	LD50	al., 1988a; Kleeman et al., 1988

Table 5-4—Summary of Toxic Effects of TCDD to Fish[a]

Test Species	Lifestage	Test Method	Organism Concentration (ng/Kg)[b]	Duration: Exposure	Duration: Observation	Effect	Reference
Rainbow trout (cont.)	Fingerling	Water (static)	650 to 2,580	6-h	42 to 139-d	Mortality, fin rot, increased liver weight	Branson et al., 1985
	Fingerling	Diet (3.2 ng/g)	314	71-d		No effect on survival and growth	Hawkes and Norris, 1977
	Fingerling	Diet (1,700 ng/g)	276,000	71-d		100% mortality	Hawkes and Norris, 1977
	Fingerling	Diet (0.494 ng/g)	250	13-wk	13-wk	No toxic effect	Kleeman et al., 1986a
	Fingerling	i.p. injection	10,000[g]	Single injection	2 to 4-wk post exposure	Fin necrosis, no effect on immune suppression	Spitsbergen et al., 1986; 1988c
	Juvenile	i.p. injection	300 to 3,060	Single injection	6 to 12-wk	Fin hemorrhage, spleen histopathology, EROD reduction,	van der Weiden et al., 1992
	Juvenile	i.p. injection	790	Single injection	3-wk	ED50 for EROD induction	van der Weiden et al., 1992
	Immature adult	i.p. injection	640	Single injection	72-h	ED50 for AHH induction	Janz and Metcalfe, 1991
Lake trout (*Salvelinus namaycush*)	Eggs to swim-up fry	Water (renewal)	34 (in eggs)	48-h	>48-h to post swim-up fry	NOAEL[e]	Walker et al., 1991
	Eggs to swim-up fry	Water (renewal)	40 (in eggs)	48-h	>48-h to post swim-up fry	23% mortality in sac fry	Walker et al., 1991
	Eggs to swim-up fry	Water (renewal)	55 (in eggs)	48-h	>48-h to post swim-up fry	LOAEL[f] (sac fry mortality)	Walker et al., 1991
	Eggs to swim-up fry	Water (renewal)	65 (in eggs)	48-h	>48-h to post swim-up fry	LR50 (sac fry)[c]	Walker et al., 1991
	Eggs to swim-up fry	Egg injection	47 (in eggs)	Single injection	Fertilized egg to swim-up fry	LR50 (sac fry)[c]	Walker et al., 1991

Table 5-4—Summary of Toxic Effects of TCDD to Fish[a]

Test Species	Lifestage	Test Method	Organism Concentration (ng/Kg)[b]	Duration: Exposure	Duration: Observation	Effect	Reference
Lake trout (cont.)	Adult	Diet[h]	59 (in eggs)	90-d	Eggs to swim-up fry	LR50 (sac fry)[c]	Walker et al., 1991; Walker et al., 1992
	Adult	Diet[h]	104 (in eggs)	90-d	Eggs to swim-up fry	100% mortality to sac fry	Walker et al., 1991; Walker et al., 1993
Carp (*Cyprinus carpio*)	Juvenile	i.p. injection	3,000[g]	Single injection	80-d	LD50	Kleeman et al., 1988
	Adult	Water (flow-thru)	2,200	71-d	61-d	Mortality and pathology	Cook et al., 1991
Bullhead (*Ictalurus melas*)	Juvenile	i.p. injection	5,000[g]	Single injection	80-d	LD50	Kleeman et al., 1988
Japanese medaka (*Oryzias latipes*)	Eggs	Water (static)	240 (in embryos)	Fertilized egg to 3-d post		ER50[i] (embryos with lesions)	Wisk and Cooper, 1990
Bluegill (*Lepomis macrochirus*)	Juvenile	i.p. injection	16,000[g]	Single injection	80-d	LD50	Kleeman et al., 1988
Largemouth bass (*Micropterus salmoides*)	Juvenile	i.p. injection	11,000[g]	Single injection	80-d	LD50	Kleeman et al., 1988
Yellow perch (*Perca flavescens*)	Juvenile	Diet	143	13-wk	13-wk	No toxic effects	Kleeman et al., 1986b
	Juvenile	i.p. injection	3,000[g]	Single injection	80-d	LD50	Spitsbergen et al., 1988b; Kleeman et al.,

Table 5-4—Summary of Toxic Effects of TCDD to Fish[a]

Test Species	Lifestage	Test Method	Organism Concentration (ng/Kg)[b]	Duration		Effect	Reference
				Exposure	Observation		
Little skate (*Raja erinacea*)	Juvenile	i.p. injection	1,000[g]	Single injection	50-d	No effect on metamorphosis	Bend et al., 1974
	Juvenile	injection	4,500[g]	Single injection	35-d	No toxic effect	Pohl et al., 1975

Table taken from *Interim Report on Data and Methods for Assessment of 2,3,7,,8-Tetrachlorodibenzo-p-dioxin Risks to Aquatic Life and Associated Wildlife* (EPA, 1993a).

i.p. = interperitoneal.

Shaded values are those chosen as toxic effect levels for risk calculations

[a] The studies cited are those which provided NOAELs or those which measured effects associated with adverse effects to population si (e.g., mortality). Studies which measured effects such as enzyme induction were not included because it is unclear how this type of effect may impact populations.

[b] Concentration TCDD measured in organism (wet weight).

[c] LR50 (corrected for control mortality) is defined as the measured residue concentration in eggs that caused 50% mortality to sac fry.

[d] NOAEL and LOAEL values (based on mean measured organism wet weight concentrations) were calculated for this report.

[e] NOAEL = No observed adverse effect level.

[f] LOAEL = Loweset observed adverse effect level.

[g] Unmeasured concentration in organism (wet weight).

[h] Diet consisted of 22 ng/g pelletized feed followed by fathead minnows injected with 500 pg/fish.

[i] ER50 is defined as the measured residue concentration in eggs that caused a 50% effect.

SECTION 6

HUMAN HEALTH RISK CHARACTERIZATION AND UNCERTAINTIES

6.1 CALCULATION AND PRESENTATION OF RISK LEVELS

Table 6-1 presents a summary of total (i.e., representing both fish and shellfish consumption) cancer risks and noncancer hazard indices for RME scenario, while total cancer risks and noncancer hazard indices for the average scenario are summarized in **Table 6-2**. **Tables 6-3** and **6-4** provide details of individual pathway and chemical contributions to total cancer risks and noncancer hazard quotients for the RME and average scenarios, respectively. Risks and hazard indices are presented for both current conditions and for projected conditions following remediation of each of the two potential cleanup areas. Projected risks following cleanup of the entire area sampled are also provided. Total cancer risks for the RME individual decreased from the nearly four in ten thousand (4E-4) under current conditions to nearly 3 in one hundred thousand (3E-5) following cleanup of all areas sampled. Cleanup of the all areas sampled results in a risk similar to that associated with Elliott Bay background conditions. Noncancer hazard quotients were 0 for both adults and children; however, this is based on evaluation of a single PAH (no other RfDs were available). PAHs in shellfish contribute the largest portion of the cancer risks. Both cancer risks and hazard quotients for the average tribal fisher, although smaller in magnitude, follow similar patterns in reduction and in primary contributors.

6.1.1 Cancer Effects

Cancer risk estimates are measures of the probability of a person developing cancer from a particular exposure (e.g., human ingestion of MSU fish and shellfish over the course of an average lifetime [70 years]). Cancer risks are calculated by multiplying estimated daily contaminant intakes (i.e., products of the summary intake factors and the exposure point concentrations, derived in **Sections 4.1.5** and **4.1.6**, respectively) by the cancer slope factor (presented in **Section 5.1.1**). These risk estimates may be expressed as the numerical chance of an individual developing cancer (e.g., four in a million), or they can be expressed in scientific notation (e.g., 4E-6).

EPA's risk management range for cancer risks is on the order of one in ten thousand to one in a million, or 1E-4 to 1E-6. Washington State MTCA guidance is similar, but with the acceptable higher risk range as one in a hundred thousand (1E-5). This means that if an individual has a less than a one in a million risk of developing cancer over a lifetime due to exposure to site-related contaminants, EPA will support a no cleanup action; but, if an individual's risk exceeds one in ten thousand, EPA will consider implementation of a cleanup strategy. Risks between 1E-4 and 1E-6 fall into EPA's risk management range, and require more information in order to determine if a cleanup action is needed. According to Washington State's MTCA guidance, risks greater than 1E-5 would require consideration of an active cleanup. The analysis of uncertainties associated with the risk estimates will aid in the risk management decision-making process by indicating, qualitatively or quantitatively, how much confidence may be placed in the risk estimates and in which direction these estimates may be skewed (i.e., whether they are over- or underestimates). Even risk estimates that fall on either side of EPA's risk management ranges, particularly those only slightly exceed range limits, are considered in light of their associated uncertainties.

Total cancer risks to RME individuals are summarized in **Table 6-1** and are detailed in **Table 6-3**. Current risks (4E-4) to the RME tribal fisher are reduced by nearly an order of magnitude (to 7E-5) following cleanup to CSLs, by half the remaining risk (to 3E-5) following cleanup to SQS levels, with no additional decrease in risk if all areas sampled were cleaned up. Therefore, the risks are within EPA's risk management range following cleanup to either CSLs or SQS. However, these levels of residual risks exceed MTCA guidance (1.0E-05).

Risks from carcinogenic PAHs in shellfish account for about 65 percent of current total RME cancer risks, and over 88 percent of total RME cancer risks following potential cleanup actions. PAH/shellfish risks to the RME individual are currently 3E-4, and subsequently drop to 4E-5, 2E-5, and 2E-5 following cleanups (CSL, SQS, or all areas sampled). All seven carcinogenic PAHs contribute to this risk, with benzo(a)pyrene contributing the largest amount, followed by benzo(a)anthracene, benzo(b)fluoranthene, and dibenz(a,h)anthracene. Cancer risks from dioxins are of less concern under current conditions and fall within EPA's risk management range following cleanup to CSLs. Cancer risks from dioxins currently exist at 1E-4 and fall to 2E-6 after cleanup to SQS levels.

Total cancer risks to tribal fishers who consume an average amount of fish and shellfish are summarized in **Table 6-2** and are detailed in **Table 6-4**. As with the RME scenario, average cancer risks decrease most substantially (from 2E-5 to 2E-6) following cleanup to CSLs, and by smaller amounts following cleanup to SQS (to just below 2E-6) or all areas sampled (to 1E-6). Unlike the RME scenario, cancer risks to the average tribal fisher fall within EPA's risk management range under current conditions. Again, these risks are primarily reflective of those posed by PAHs in shellfish, with benzo(a)pyrene being the greatest individual contributor. Current dioxin risks are 6E-6, dropping to 3E-7 after the cleanup to SQS.

The uncertainties associated with these carcinogenic risk estimates are described in **Section 6.2**.

6.1.2 Non-Cancer Hazard Quotients

Non-cancer effects are measured using a hazard quotient approach. Hazard quotients (HQs) are ratios of the actual dose of a particular contaminant from the MSU media compared to a reference dose associated with no or low human health effects for that contaminant. As discussed in **Section 5.1**, the reference dose is an amount of contaminant to which a person may be exposed, below which no adverse human health effects are expected to occur. Hazard indices

(HIs) are then calculated by summing the HQs associated with all pathways and exposure scenarios to quantify the total potential for noncancer health impacts. EPA usually considers HIs of less than 1.0 to warrant no cleanup action, while HIs of greater than 1.0 may support the need to consider a cleanup action. Akin to the way cancer risks are examined, all HIs are considered in light of associated uncertainties.

Noncancer HIs to RME individuals were based only on health hazards from pyrene and are summarized in **Table 6-1** and are detailed in **Table 6-3**. Under current conditions, HIs based on exposure to pyrene are less then 1.0 for both adults and children. Because dioxins were assessed only for carcinogenic impacts, these values reflect only potential impacts from noncarcinogenic PAHs (only one of which, pyrene, is quantitatively evaluated in this assessment).

Noncancer HIs to average tribal fishers are summarized in **Table 6-2** and are detailed in **Table 6-4**. All HIs calculated are also below 1.0.

The uncertainties associated with these noncancer HIs are described in **Section 6.2**.

6.2 UNCERTAINTY ANALYSIS

Uncertainties associated with the exposure and toxicity components of this analysis were introduced in **Sections 4.1.7** and **5.1.2**, respectively. **Table 6-5** presents a summary of uncertainties and their potential impact upon the calculated cancer risk and noncancer HI estimates. These uncertainty factors are discussed in conjunction with estimated cancer risks and noncancer HIs in the following paragraphs.

6.2.1 Exposure Uncertainties

6.2.1.1 Land Use Assumptions

Human use of the MSU was assumed to be limited to those activities associated with access via the water (i.e., harvesting of fish and shellfish by boat). Current conditions include restricted access to the shoreline. Potential access to the shoreline may be allowed following sediment remediation. Therefore, it is unlikely that this assumption will result in any underestimate of risks.

6.2.1.2 Fish and Shellfish Exposure Assumptions

The extent to which fish and shellfish are exposed to site-related contaminants will vary depending on a number of factors. Some of these factors, including the home range of finfish, the feeding habits of shellfish, and the similarity in contaminant uptake among different types of fish and shellfish, introduce uncertainty into the risk assessment.

English sole, the bottom fish used in the human health risk assessment, have a limited home range. Therefore, it was assumed that they would receive 100 percent of their contaminant exposure from the PSR MSU. As mentioned in **Section 4.1**, should the home range of these fish extend significantly beyond the boundaries of the site, site-specific risks calculated for current conditions would be overestimated. Conversely, because of the proportional reduction in contamination assumed to occur in fish with respect to site sediment concentrations, residual risk estimates following cleanup of different areas of the site may be underestimated. However, due to the limited home range of these fish, the 100 percent assumption will likely not result in substantial misrepresentation of risks.

A single species of bottom fish was used to represent exposures to all bottom fish at the site. Bioaccumulation of contaminants depends on a number of factors, including the lipid content of the organism as well as the behaviors (e.g., the amount of time they spend in sediment versus the amount of time in the water column) of the organism. English sole have been found to accumulate more of some contaminants than some fish, and less than others. Additionally, bottom fish spend a significant amount of time on or burrowed in the sediment. For these reasons, use of English sole to represent bottom fish likely did not result in a significant overall over- or underestimation of risks.

6.2.1.3 Human Exposure Assumptions

Values chosen to represent human exposure parameters at the site may also contribute uncertainty to risk estimates. Relevant parameters in this evaluation include the choice of an RME scenario, consumption habits, exposure duration and frequency, and the fraction of the consumed fish acquired from the site.

The choice of a high-end tribal fishing scenario to represent reasonable maximum exposure at the site was a logical choice. Not only do two Native American tribes have Treaty fishing rights to areas including the MSU, but tribal members have been documented as regularly harvesting fish from Elliott Bay. Although other subsistence fishers may utilize Elliott Bay, their consumption habits are not well known. Conversely, a relatively recent seafood consumption study that does document the habits of two different Native American tribes in the Puget Sound area provided the information for application of regional data to the assessment. Based on existing information, the choice of the tribal fishing population for evaluation in the human health risk assessment likely does not result in any underestimation of risk.

This risk assessment was based on contaminant concentrations measured in fish fillets (as opposed to whole-body fish). Based on habits of other Puget Sound tribes (as reported in Toy, et al. 1996), this was a reasonable assumption, as greater than 80 percent of those tribal members consuming fish limit their intake to fish fillets. If other subsistence populations in the area consume additional parts (e.g., liver, skin) of the fish, risks may be underestimated. However, major differences in the concentrations between whole-body tissue samples and fillet tissue samples were not observed in site data. Therefore, it is unlikely that altering this assumption would substantially change the risk estimates.

Tribal members are assumed to be exposed to fish from the PSR MSU for a total duration of 30 years. This is EPA's default RME exposure duration based an upper end estimate of time a person lives at one residence. This residency time does not include the total time an individual spends at multiple residences in the same area from which similar recreational areas (such as fishing spots) may be retained. A person who spends more than 30 years in the vicinity of the PSR site, and subsists on fish from the site throughout their residence in the area, may be at a higher risk than estimated in this assessment. However, no documentation is available to substantiate and quantify this possibility. Additionally, should no individuals subsist on fish and shellfish from the site for a full 30 years, risks may be overestimated. However, there is no documentation indicating this to be a likely possibility.

Tribal members were also assumed to be exposed to fish and shellfish from the PSR MSU for only six months per year. As discussed in **Section 4**, this is due to limitations on harvesting to the period of time between approximately mid-April and mid-October. Based on information from the Washington State Department of Fish and Wildlife (Cain 1997), harvesting time may be further reduced by resource and quota limitations. In 1997, commercial fishers acquired their quota of shellfish in only five weeks. For these reasons, it is unlikely that subsistence fishers will be able to fully utilize the PSR MSU area for harvesting of fish and shellfish for a full six months per year, in which case, risks are likely to be overestimated.

Of the types of shellfish reported to be consumed by Puget Sound Native American tribes (Toy et al. 1996), only crabs and other mobile shellfish were determined to be accessible at the site and available in quantities that could support subsistence fishing. This was based on the availability and observed harvesting of spot prawns in the vicinity of the site. Should subsistence fishers in the future be able to gather sessile shellfish (such as clams) from the site, risks may be underestimated. However, based on access restrictions to the shoreline, limited intertidal habitat for clams and other sessile shellfish, and the likely remediation of nearshore sediment, risks are not likely to increase due to sessile shellfish consumption issues.

As established in the PSR MSU Work Plan (WESTON 1996b), it was assumed that an individual may obtain 100 percent of all fish and mobile shellfish that he or she consumes from Puget Sound from the site. Since fishing operations have been documented as occurring in Elliott Bay, it is possible that an individual may obtain all bottom fish that they consume from the site. However, based an analysis (Liao and Polissar 1996) of data from the Toy et al. study (1996), it was determined that individuals harvest shellfish from an average of approximately two locations. Therefore, risks may be overestimated by up to two times, assuming equal utilization of the two areas. However, because harvesting was only expected to occur from the PSR site for six months of the year, the use of a second site may have been implicitly accounted for due to the need to find an alternate location for the remaining six months of the year. The impact on risk estimates, from the use of multiple harvesting locations, may range from a negligible amount to a substantial percentage reduction; however available data are not sufficient to quantify these potential impacts.

6.2.1.4 Exposure Point Concentrations

Exposure point concentrations were developed for both fish and shellfish at the site, under current conditions and under projected conditions following incrementally greater cleanups (CSL, SQS, or the entire site). These values were developed based on chemical data from sampling events at the site. Aspects of the collection and interpretation of these data lend uncertainty to the risk estimates derived with them. Some of these aspects include the sample sizes of fish and shellfish, the use of an arithmetic mean to collectively represent the data, assumption that chemical concentrations will not decrease over time, use of half the detection limit to represent contaminant concentrations in undetected samples, the use of a bioaccumulation model to represent contaminant concentrations in fish and shellfish, and the assumption that 100 percent of contaminant concentrations measured in fish and shellfish are bioavailable to people consuming these organisms.

Only six fish fillet samples and nine clam samples were available for analysis. A small number of samples may not accurately depict contaminant concentrations across the site. This is particularly true with regard to determination of reductions in risk following cleanup of selected areas of the site. For this reason, tissue samples from clams exposed to PSR sediment and from fish collected at the site were used to determine human health COPCs, but they were not used to represent site-wide exposure point concentrations.

While modeling of fish and shellfish concentrations based on sediment contaminant concentrations throughout the site allowed for a better representation of overall potential risks, it introduced some uncertainties into the assessment. The bioaccumulation model used to develop exposure point concentrations in fish and shellfish was dependent on estimates of fish and shellfish lipid concentrations, a site-wide organic carbon fraction, and a literature-based biota sediment accumulation factor. Should the fish or shellfish consumed from the PSR site (i.e., the spot prawns and crabs) have significantly different lipid fractions than the samples on which the lipid fraction was based, risks may be over- or underestimated accordingly. Similarly, should these organisms bioaccumulate contaminants at significantly different rates than those organisms used to develop the literature values, risks may be over- or underestimated accordingly.

EPA recommends use of the arithmetic mean (and upper percentile of that mean) to estimate exposure point concentrations (EPA 1992c). If concentrations at the site form a lognormal distribution, then use of an arithmetic mean may overestimate the actual exposure point concentrations. However, use of the arithmetic mean may help to ensure that organisms disproportionally exposed to areas of elevated contaminant concentrations (e.g., due to affinity for a particular part of the site habitat) are adequately accounted for in risk estimates. This factor is not likely to result in substantially overestimated risks at the PSR MSU.

Contaminant concentrations in MSU media (including sediment, clams, and English sole) were assumed to remain constant over the exposure period considered. Because the site is located in an industrialized area, it is not likely that contaminant concentrations will be significantly diluted over time due to mixing with surrounding sediment. Additionally, COPCs selected for this assessment are stable compounds that are not likely to break down rapidly over time. However, these contaminants are likely to bind strongly with sediment and to remain there for extended periods. This indicates that the assumption of static contaminant concentrations will not result in a substantial overestimate of risks at the site. However, due to contaminant binding to sediment, it is likely that organisms exposed to contaminants primarily via the water column (e.g., mussels or prawns) will be exposed to lower concentrations of contaminants over time. Sediment-dwelling organisms (e.g., bottom fish and clams), however, will continue to be exposed to elevated contaminant concentrations.

As discussed above, concentrations of contaminants that were not detected in site samples were represented by one half the reported sample detection limit. Since this may overestimate some concentrations and underestimate others, it is not expected to have a significant impact on risk estimates.

Contaminants detected in fish and shellfish at the site were assumed to be 100 percent bioavailable to people consuming these organisms. While it is possible that some portion of these contaminants may not be taken up by people, it is likely that the larger portion of these contaminants will be available to people. The COPCs were selected, in part, because they are bioaccumulative compounds that are more readily taken up by biological organisms, including people. Furthermore, these COPCs are organic compounds, and it is inorganic compounds that are more commonly at issue with bioavailability. Therefore, risks are not expected to be significantly overestimated due to the assumption of 100 percent bioavailability of contaminants.

6.2.2 Toxicity Uncertainties

6.2.2.1 Unavailable Toxicity Factors

Toxicity factors were not available for all COPCs elevated in the risk assessment. This issue was addressed in many ways, including application of a surrogate value, application of modified surrogate values, and omission of contaminants from quantitative evaluation.

Of the seven carcinogenic PAHs selected as COPCs, only benzo(a)pyrene had a CSF available for evaluation of cancer risks. Because these contaminants are functionally similar, EPA developed a relationship between the expected cancer potency of the remaining six carcinogenic PAHs and the cancer potency of the benzo(a)pyrene. This is referred to as an equivalency approach. Each compound is assigned a factor that relates its toxicity to that of the selected compound. Concentrations of all relevant compounds are multiplied by their respective toxicity equivalency factors and are summed to give a total concentration of equivalents, benzo(a) pyrene equivalents in this case. Toxicity is then evaluated using the toxicity values (e.g., CSF) for the base compound (in this case, the benzo(a)pyrene). A similar relationship was used to evaluate toxicity of dioxins and furans, based on 2,3,7,8-tetrachlorodibenzodioxin (TCDD) equivalents. In both cases, it is possible that risks may be over- or underestimated, but this should not significantly impact confidence in risk assessment results.

Two PAH compounds (benzo(g,h,i)perylene and phenanthrene) did not have either CSFs or RfDs available for evaluation. However, the concentrations of these PAHs were not elevated to the same extent that some other PAHs were, thereby indicating that although total risks or total hazards may be underestimated, other contaminants will serve as adequate indicator compounds for making cleanup decisions and these PAHs will still benefit from any remedial actions taken at the site.

6.2.2.2 Derivation of Toxicity Factors

The derivation of EPA toxicity values is effected by uncertainties due to its input factors as well. However, the EPA CSFs and RfDs are those values most consistently applied to Superfund risk assessments and they are based on an extensive review of current data and practices. While some EPA toxicity values may suggest reasons that risks and hazards are underestimated, other EPA toxicity values may suggest reasons that risks and hazards are underestimated. The potential impact of toxicity factor uncertainties on risk estimates is not substantial for this particular evaluation.

6.3 SUMMARY OF RISKS

Cancer risks to the average tribal fisher currently fall within EPA's risk management range. Cancer risks to the RME tribal fisher are elevated under current conditions (4E-4) and drop substantially following cleanup to CSLs (to 7E-5) to being on the order of EPA's cancer risk management range. Noncancer hazard indices for the average and RME tribal fisher are below 1 for the single PAH evaluated. Cancer risks are currently the most significant concern, and specifically, cancer risks from PAHs in shellfish. As discussed above, although actual exposures were quantified to best represent a reasonable maximum exposure, uncertainty related to potentially reduced exposure duration and utilization of the PSR MSU for harvesting of fish and shellfish, suggest that calculated risk values may overestimate actual risks to subsistence fishers who utilize the PSR site. However, cleanup to CSLs alone will result in a substantial decrease to risk estimates that fall within EPA's general risk management threshold.

Table 6-1—Summary of Total Cancer Risks and Noncancer Hazard Indices to RME Tribal Fishers due to Consumption of Both Fish and Shellfish from the Marine Sediments Unit of the PSR Superfund Site

Chemical	Residual Risk Based on No Cleanup			Residual Risk Following Cleanup to CSL			Residual Risk Following Cleanup to SQS			Residual Risk Following Risk-Based Cleanup			Residual Risk for Elliott Bay Background		
	Total (Fish and Shellfish)			Total (Fish and Shellfish)			Total (Fish and Shellfish)			Total (Fish and Shellfish)			Total (Fish and Shellfish)		
	Lifetime CR	Adult HQ	Child HQ	Lifetime CR	Adult HQ	Child HQ	Lifetime CR	Adult HQ	Child HQ	Lifetime CR	Adult HQ	Child HQ	Lifetime CR	Adult HQ	Child HQ
TOTAL PAH RISKS	*2.7E-04*	*0.0*	*0.0*	*4.0E-05*	*0.0*	*0.0*	*2.2E-05*	*0.0*	*0.0*	*2.2E-05*	*0.0*	*0.0*	*2.8E-05*	*0.0*	*0.0*
TOTAL DIOXIN RISKS	*1.8E-04*	*NA*	*NA*	*2.5E-05*	*NA*	*NA*	*3.4E-06*	*NA*	*NA*	*3.4E-06*	*NA*	*NA*	*1.9E-06*	*NA*	*NA*
TOTAL RISKS	**4.5E-04**	**0.0**	**0.0**	**6.6E-05**	**0.0**	**0.0**	**2.5E-05**	**0.0**	**0.0**	**2.5E-05**	**0.0**	**0.0**	**2.9E-05**	**0.0**	**0.0**

NA: Not applicable or available

Table 6-2—Summary of Total Cancer Risks and Noncancer Hazard Indices to Average Tribal Fishers due to Consumption of Both Fish and Shellfish from the Marine Sediments Unit of the PSR Superfund Site

	Residual Risk Based on *No Cleanup*			Residual Risk Following Cleanup *to CSL*			Residual Risk Following Cleanup *to SQS*			Residual Risk Following *Risk-Based Cleanup*			Residual Risk for Elliott Bay *Background*		
	Total (Fish and Shellfish)			Total (Fish and Shellfish)			Total (Fish and Shellfish)			Total (Fish and Shellfish)			Total (Fish and Shellfish)		
Chemical	Lifetime CR	Adult HQ	Child HQ	Lifetime CR	Adult HQ	Child HQ	Lifetime CR	Adult HQ	Child HQ	Lifetime CR	Adult HQ	Child HQ	Lifetime CR	Adult HQ	Child HQ
TOTAL PAH RISKS	*1.1E-05*	*0.0*	*0.0*	*1.7E-06*	*0.0*	*0.0*	*1.3E-06*	*0.0*	*0.0*	*1.3E-06*	*0.0*	*0.0*	*1.7E-06*	*0.0*	*0.0*
TOTAL DIOXIN RISKS	*5.9E-06*	*NA*	*NA*	*6.7E-07*	*NA*	*NA*	*3.2E-07*	*NA*	*NA*	*2.3E-07*	*NA*	*NA*	*1.3E-07*	*NA*	*NA*
TOTAL RISKS	**1.7E-05**	**0.0**	**0.0**	**2.4E-06**	**0.0**	**0.0**	**1.6E-06**	**0.0**	**0.0**	**1.6E-06**	**0.0**	**0.0**	**1.8E-06**	**0.0**	**0.0**

NA: Not applicable or available

Table 6-3a—Current and Residual Cancer Risks and Noncancer Hazard Quotients for RME Tribal Fishers due to Consumption of Fish and Shellfish from the Marine Sediments Unit of the PSR Superfund Site

	Residual Risk Based on No Cleanup										
	Residual Concentrations (µg/kg)		Fish			Shellfish			Total (Fish and Shellfish)		
			Lifetime	Adult	Child	Lifetime	Adult	Child	Lifetime	Adult	Child
Chemical	Fish Tissue	Shellfish Tissue	CR	HQ	HQ	CR	HQ	HQ	CR	HQ	HQ
Polycyclic Aromatic Hydrocarbons											
Benzo(g,h,i)perylene	N/A	75	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	N/A	933	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	N/A	2674	NA	NA	NA	NA	0.0	0.0	NA	0.0	0.0
Total B(a)P equivalent	N/A	432	NA	NA	NA	2.7E-04	NA	NA	2.7E-04	NA	NA
Benzo(a)anthracene	N/A	495	*NA*	*NA*	*NA*	*3.1E-05*	*NA*	*NA*	*3.1E-05*	*NA*	*NA*
Chrysene	N/A	572	*NA*	*NA*	*NA*	*3.6E-07*	*NA*	*NA*	*3.6E-07*	*NA*	*NA*
Benzo(b)fluoranthene	N/A	659	*NA*	*NA*	*NA*	*4.1E-05*	*NA*	*NA*	*4.1E-05*	*NA*	*NA*
Benzo(k)fluoranthene	N/A	211	*NA*	*NA*	*NA*	*1.3E-06*	*NA*	*NA*	*1.3E-06*	*NA*	*NA*
Benzo(a)pyrene	N/A	307	*NA*	*NA*	*NA*	*1.9E-04*	*NA*	*NA*	*1.9E-04*	*NA*	*NA*
Indeno(1,2,3-cd)pyrene	N/A	92	*NA*	*NA*	*NA*	*5.8E-06*	*NA*	*NA*	*5.8E-06*	*NA*	*NA*
Dibenz(a,h)anthracene	N/A	25	*NA*	*NA*	*NA*	*1.6E-05*	*NA*	*NA*	*1.6E-05*	*NA*	*NA*
Dioxins/Furans											
Total 2,3,7,8-TCDD(Equiv)	0	0.008	7.4E-05	NA	NA	1.1E-04	NA	NA	1.8E-04	NA	NA
TOTAL PAH RISKS			*0.0E+00*	*0.0*	*0.0*	*2.7E-04*	*0.0*	*0.0*	*2.7E-04*	*0.0*	*0.0*
TOTAL DIOXIN RISKS			*7.4E-05*	*NA*	*NA*	*1.1E-04*	*NA*	*NA*	*1.8E-04*	*NA*	*NA*
TOTAL RISKS			**7.4E-05**	**0.0**	**0.0**	**3.8E-04**	**0.0**	**0.0**	**4.6E-04**	**0.0**	**0.0**

NA: Not applicable or available

Table 6-3b—Current and Residual Cancer Risks and Noncancer Hazard Quotients for RME Tribal Fishers due to Consumption of Fish and Shellfish from the Marine Sediments Unit of the PSR Superfund Site

			Residual Risk Following Cleanup to CSL								
	Residual Concentrations (µg/kg)		Fish			Shellfish			Total (Fish and Shellfish)		
			Lifetime	Adult	Child	Lifetime	Adult	Child	Lifetime	Adult	Child
Chemical	Fish Tissue	Shellfish Tissue	CR	HQ	HQ	CR	HQ	HQ	CR	HQ	HQ
Polycyclic Aromatic Hydrocarbons											
Benzo(g,h,i)perylene	N/A	19	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	N/A	80	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	N/A	148	NA	NA	NA	NA	0.0	0.0	NA	0.0	0.0
Total B(a)P equivalent	N/A	64	NA	NA	NA	4.0E-05	NA	NA	4.0E-05	NA	NA
Benzo(a)anthracene	N/A	39	*NA*	*NA*	*NA*	*2.5E-06*	*NA*	*NA*	*2.5E-06*	*NA*	*NA*
Chrysene	N/A	61	*NA*	*NA*	*NA*	*3.8E-08*	*NA*	*NA*	*3.8E-08*	*NA*	*NA*
Benzo(b)fluoranthene	N/A	65	*NA*	*NA*	*NA*	*4.1E-06*	*NA*	*NA*	*4.1E-06*	*NA*	*NA*
Benzo(k)fluoranthene	N/A	25	*NA*	*NA*	*NA*	*1.5E-07*	*NA*	*NA*	*1.5E-07*	*NA*	*NA*
Benzo(a)pyrene	N/A	44	*NA*	*NA*	*NA*	*2.7E-05*	*NA*	*NA*	*2.7E-05*	*NA*	*NA*
Indeno(1,2,3-cd)pyrene	N/A	21	*NA*	*NA*	*NA*	*1.3E-06*	*NA*	*NA*	*1.3E-06*	*NA*	*NA*
Dibenz(a,h)anthracene	N/A	6	*NA*	*NA*	*NA*	*3.8E-06*	*NA*	*NA*	*3.8E-06*	*NA*	*NA*
Dioxins/Furans											
Total 2,3,7,8-TCDD(Equiv)	0.007	0.001	1.1E-05	NA	NA	1.5E-05	NA	NA	2.5E-05	NA	NA
TOTAL PAH RISKS			*0.0E+00*	*0.0*	*0.0*	*4.0E-05*	*0.0*	*0.0*	*4.0E-05*	*0.0*	*0.0*
TOTAL DIOXIN RISKS			*1.1E-05*	*NA*	*NA*	*1.5E-05*	*NA*	*NA*	*2.5E-05*	*NA*	*NA*
TOTAL RISKS			**1.1E-05**	**0.0**	**0.0**	**5.5E-05**	**0.0**	**0.0**	**6.6E-05**	**0.0**	**0.0**

NA: Not applicable or available

Table 6-3c—Current and Residual Cancer Risks and Noncancer Hazard Quotients for RME Tribal Fishers due to Consumption of Fish and Shellfish from the Marine Sediments Unit of the PSR Superfund Site

	Residual Risk Following Cleanup to SQS										
	Residual Concentrations (µg/kg)		Fish			Shellfish			Total (Fish and Shellfish)		
			Lifetime	Adult	Child	Lifetime	Adult	Child	Lifetime	Adult	Child
Chemical	Fish Tissue	Shellfish Tissue	CR	HQ	HQ	CR	HQ	HQ	CR	HQ	HQ
Polycyclic Aromatic Hydrocarbons											
Benzo(g,h,i)perylene	N/A	12	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	N/A	41	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	N/A	71	NA	NA	NA	NA	0.0	0.0	NA	0.0	0.0
Total B(a)P equivalent	N/A	35	NA	NA	NA	2.2E-05	NA	NA	2.2E-05	NA	NA
Benzo(a)anthracene	N/A	27	*NA*	*NA*	*NA*	*1.7E-06*	*NA*	*NA*	*1.7E-06*	*NA*	*NA*
Chrysene	N/A	32	*NA*	*NA*	*NA*	*2.0E-08*	*NA*	*NA*	*2.0E-08*	*NA*	*NA*
Benzo(b)fluoranthene	N/A	27	*NA*	*NA*	*NA*	*1.7E-06*	*NA*	*NA*	*1.7E-06*	*NA*	*NA*
Benzo(k)fluoranthene	N/A	11	*NA*	*NA*	*NA*	*7.2E-08*	*NA*	*NA*	*7.2E-08*	*NA*	*NA*
Benzo(a)pyrene	N/A	25	*NA*	*NA*	*NA*	*1.6E-05*	*NA*	*NA*	*1.6E-05*	*NA*	*NA*
Indeno(1,2,3-cd)pyrene	N/A	12	*NA*	*NA*	*NA*	*7.8E-07*	*NA*	*NA*	*7.8E-07*	*NA*	*NA*
Dibenz(a,h)anthracene	N/A	3	*NA*	*NA*	*NA*	*2.0E-06*	*NA*	*NA*	*2.0E-06*	*NA*	*NA*
Dioxins/Furans											
Total 2,3,7,8-TCDD(Equiv)	0.001	0.000	1.4E-06	NA	NA	2.0E-06	NA	NA	3.4E-06	NA	NA
TOTAL PAH RISKS			*0.0E+00*	*0.0*	*0.0*	*2.2E-05*	*0.0*	*0.0*	*2.2E-05*	*0.0*	*0.0*
TOTAL DIOXIN RISKS			*1.4E-06*	*NA*	*NA*	*2.0E-06*	*NA*	*NA*	*3.4E-06*	*NA*	*NA*
TOTAL RISKS			**1.4E-06**	**0.0**	**0.0**	**2.4E-05**	**0.0**	**0.0**	**2.5E-05**	**0.0**	**0.0**

NA: Not applicable or available

Table 6-3d—Current and Residual Cancer Risks and Noncancer Hazard Quotients for RME Tribal Fishers due to Consumption of Fish and Shellfish from the Marine Sediments Unit of the PSR Superfund Site

	Residual Risk Following Risk-Based Cleanup										
	Residual Concentrations (µg/kg)		Fish			Shellfish			Total (Fish and Shellfish)		
			Lifetime	Adult	Child	Lifetime	Adult	Child	Lifetime	Adult	Child
Chemical	Fish Tissue	Shellfish Tissue	CR	HQ	HQ	CR	HQ	HQ	CR	HQ	HQ
Polycyclic Aromatic Hydrocarbons											
Benzo(g,h,i)perylene	N/A	12	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	N/A	41	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	N/A	71	NA	NA	NA	NA	0.0	0.0	NA	0.0	0.0
Total B(a)P equivalent	N/A	35	NA	NA	NA	2.2E-05	NA	NA	2.2E-05	NA	NA
Benzo(a)anthracene	N/A	27	*NA*	*NA*	*NA*	*1.7E-06*	*NA*	*NA*	*1.7E-06*	*NA*	*NA*
Chrysene	N/A	32	*NA*	*NA*	*NA*	*2.0E-08*	*NA*	*NA*	*2.0E-08*	*NA*	*NA*
Benzo(b)fluoranthene	N/A	27	*NA*	*NA*	*NA*	*1.7E-06*	*NA*	*NA*	*1.7E-06*	*NA*	*NA*
Benzo(k)fluoranthene	N/A	11	*NA*	*NA*	*NA*	*7.2E-08*	*NA*	*NA*	*7.2E-08*	*NA*	*NA*
Benzo(a)pyrene	N/A	25	*NA*	*NA*	*NA*	*1.6E-05*	*NA*	*NA*	*1.6E-05*	*NA*	*NA*
Indeno(1,2,3-cd)pyrene	N/A	12	*NA*	*NA*	*NA*	*7.8E-07*	*NA*	*NA*	*7.8E-07*	*NA*	*NA*
Dibenz(a,h)anthracene	N/A	3	*NA*	*NA*	*NA*	*2.0E-06*	*NA*	*NA*	*2.0E-06*	*NA*	*NA*
Dioxins/Furans											
Total 2,3,7,8-TCDD(Equiv)	0.001	0.000	1.4E-06	NA	NA	2.0E-06	NA	NA	3.4E-06	NA	NA
TOTAL PAH RISKS			*0.0E+00*	*0.0*	*0.0*	*2.2E-05*	*0.0*	*0.0*	*2.2E-05*	*0.0*	*0.0*
TOTAL DIOXIN RISKS			*1.4E-06*	*NA*	*NA*	*2.0E-06*	*NA*	*NA*	*3.4E-06*	*NA*	*NA*
TOTAL RISKS			**1.4E-06**	**0.0**	**0.0**	**2.4E-05**	**0.0**	**0.0**	**2.5E-05**	**0.0**	**0.0**

NA: Not applicable or available

Table 6-3e—Current and Residual Cancer Risks and Noncancer Hazard Quotients for RME Tribal Fishers due to Consumption of Fish and Shellfish from the Marine Sediments Unit of the PSR Superfund Site

	Residual Concentrations (µg/kg)		Residual Risk for Elliott Bay Background								
			Fish			Shellfish			Total (Fish and Shellfish)		
			Lifetime	Adult	Child	Lifetime	Adult	Child	Lifetime	Adult	Child
Chemical	Fish Tissue	Shellfish Tissue	CR	HQ	HQ	CR	HQ	HQ	CR	HQ	HQ
Polycyclic Aromatic Hydrocarbons											
Benzo(g,h,i)perylene	N/A	6	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	N/A	7	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	N/A	21	NA	NA	NA	NA	0.0	0.0	NA	0.0	0.0
Total B(a)P equivalent	N/A	44	NA	NA	NA	2.8E-05	NA	NA	2.8E-05	NA	NA
Benzo(a)anthracene	N/A	26	*NA*	*NA*	*NA*	*1.6E-06*	*NA*	*NA*	*1.6E-06*	*NA*	*NA*
Chrysene	N/A	9	*NA*	*NA*	*NA*	*5.6E-09*	*NA*	*NA*	*5.6E-09*	*NA*	*NA*
Benzo(b)fluoranthene	N/A	15	*NA*	*NA*	*NA*	*9.3E-07*	*NA*	*NA*	*9.3E-07*	*NA*	*NA*
Benzo(k)fluoranthene	N/A	5	*NA*	*NA*	*NA*	*3.0E-08*	*NA*	*NA*	*3.0E-08*	*NA*	*NA*
Benzo(a)pyrene	N/A	11	*NA*	*NA*	*NA*	*6.8E-06*	*NA*	*NA*	*6.8E-06*	*NA*	*NA*
Indeno(1,2,3-cd)pyrene	N/A	6	*NA*	*NA*	*NA*	*3.6E-07*	*NA*	*NA*	*3.6E-07*	*NA*	*NA*
Dibenz(a,h)anthracene	N/A	26	*NA*	*NA*	*NA*	*1.6E-05*	*NA*	*NA*	*1.6E-05*	*NA*	*NA*
Dioxins/Furans											
Total 2,3,7,8-TCDD(Equiv)	0.001	0.000	1.3E-06	NA	NA	5.3E-07	NA	NA	1.9E-06	NA	NA
TOTAL PAH RISKS			*0.0E+00*	*0.0*	*0.0*	*2.8E-05*	*0.0*	*0.0*	*2.8E-05*	*0.0*	*0.0*
TOTAL DIOXIN RISKS			*1.3E-06*	*NA*	*NA*	*5.3E-07*	*NA*	*NA*	*1.9E-06*	*NA*	*NA*
TOTAL RISKS			**1.3E-06**	**0.0**	**0.0**	**2.8E-05**	**0.0**	**0.0**	**2.9E-05**	**0.0**	**0.0**

NA NA: Not applicable or available

Table 6-4a—Current and Residual Cancer Risks and Noncancer Hazard Quotients for Average Tribal Fishers due to Consumption of Fish and Shellfish from the Marine Sediments Unit of the PSR Superfund Site

Chemical	Residual Concentrations (µg/kg)		Residual Risk Based on No Cleanup								
			Fish			Shellfish			Total (Fish and Shellfish)		
	Fish Tissue	Shellfish Tissue	Lifetime CR	Adult HQ	Child HQ	Lifetime CR	Adult HQ	Child HQ	Lifetime CR	Adult HQ	Child HQ
Polycyclic Aromatic Hydrocarbons											
Benzo(g,h,i)perylene	N/A	50	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	N/A	1629	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	N/A	1665	NA	NA	NA	NA	0.0	0.0	NA	0.0	0.0
Total B(a)P equivalent	N/A	280	NA	NA	NA	1.1E-05	NA	NA	1.1E-05	NA	NA
Benzo(a)anthracene	N/A	434	*NA*	*NA*	*NA*	*1.7E-06*	*NA*	*NA*	*1.7E-06*	*NA*	*NA*
Chrysene	N/A	579	*NA*	*NA*	*NA*	*2.2E-08*	*NA*	*NA*	*2.2E-08*	*NA*	*NA*
Benzo(b)fluoranthene	N/A	347	*NA*	*NA*	*NA*	*1.3E-06*	*NA*	*NA*	*1.3E-06*	*NA*	*NA*
Benzo(k)fluoranthene	N/A	130	*NA*	*NA*	*NA*	*5.1E-08*	*NA*	*NA*	*5.1E-08*	*NA*	*NA*
Benzo(a)pyrene	N/A	177	*NA*	*NA*	*NA*	*6.9E-06*	*NA*	*NA*	*6.9E-06*	*NA*	*NA*
Indeno(1,2,3-cd)pyrene	N/A	60	*NA*	*NA*	*NA*	*2.3E-07*	*NA*	*NA*	*2.3E-07*	*NA*	*NA*
Dibenz(a,h)anthracene	N/A	19	*NA*	*NA*	*NA*	*7.3E-07*	*NA*	*NA*	*7.3E-07*	*NA*	*NA*
Dioxins/Furans											
Total 2,3,7,8-TCDD(Equiv)	0.025	0.004	2.7E-06	NA	NA	3.2E-06	NA	NA	5.9E-06	NA	NA
TOTAL PAH RISKS			*0.0E+00*	*0.0*	*0.0*	*1.1E-05*	*0.0*	*0.0*	*1.1E-05*	*0.0*	*0.0*
TOTAL DIOXIN RISKS			*2.7E-06*	*NA*	*NA*	*3.2E-06*	*NA*	*NA*	*5.9E-06*	*NA*	*NA*
TOTAL RISKS			**2.7E-06**	**0.0**	**0.0**	**1.4E-05**	**0.0**	**0.0**	**1.7E-05**	**0.0**	**0.0**

NA: Not applicable or available

Table 6-4b—Current and Residual Cancer Risks and Noncancer Hazard Quotients for Average Tribal Fishers due to Consumption of Fish and Shellfish from the Marine Sediments Unit of the PSR Superfund Site

	Residual Risk Following Cleanup to CSL										
	Residual Concentrations (µg/kg)		Fish			Shellfish			Total (Fish and Shellfish)		
			Lifetime	Adult	Child	Lifetime	Adult	Child	Lifetime	Adult	Child
Chemical	Fish Tissue	Shellfish Tissue	CR	HQ	HQ	CR	HQ	HQ	CR	HQ	HQ
Polycyclic Aromatic Hydrocarbons											
Benzo(g,h,i)perylene	N/A	14	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	N/A	54	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	N/A	96	NA	NA	NA	NA	0.0	0.0	NA	0.0	0.0
Total B(a)P equivalent	N/A	44	NA	NA	NA	1.7E-06	NA	NA	1.7E-06	NA	NA
Benzo(a)anthracene	N/A	30	*NA*	*NA*	*NA*	*1.2E-07*	*NA*	*NA*	*1.2E-07*	*NA*	*NA*
Chrysene	N/A	43	*NA*	*NA*	*NA*	*1.7E-09*	*NA*	*NA*	*1.7E-09*	*NA*	*NA*
Benzo(b)fluoranthene	N/A	45	*NA*	*NA*	*NA*	*1.7E-07*	*NA*	*NA*	*1.7E-07*	*NA*	*NA*
Benzo(k)fluoranthene	N/A	16	*NA*	*NA*	*NA*	*6.3E-09*	*NA*	*NA*	*6.3E-09*	*NA*	*NA*
Benzo(a)pyrene	N/A	31	*NA*	*NA*	*NA*	*1.2E-06*	*NA*	*NA*	*1.2E-06*	*NA*	*NA*
Indeno(1,2,3-cd)pyrene	N/A	15	*NA*	*NA*	*NA*	*5.8E-08*	*NA*	*NA*	*5.8E-08*	*NA*	*NA*
Dibenz(a,h)anthracene	N/A	4	*NA*	*NA*	*NA*	*1.6E-07*	*NA*	*NA*	*1.6E-07*	*NA*	*NA*
Dioxins/Furans											
Total 2,3,7,8-TCDD(Equiv)	0.003	0.000	3.0E-07	NA	NA	3.6E-07	NA	NA	6.7E-07	NA	NA
TOTAL PAH RISKS			*0.0E+00*	*0.0*	*0.0*	*1.7E-06*	*0.0*	*0.0*	*1.7E-06*	*0.0*	*0.0*
TOTAL DIOXIN RISKS			*3.0E-07*	*NA*	*NA*	*3.6E-07*	*NA*	*NA*	*6.7E-07*	*NA*	*NA*
TOTAL RISKS			**3.0E-07**	**0.0**	**0.0**	**2.1E-06**	**0.0**	**0.0**	**2.4E-06**	**0.0**	**0.0**

NA: Not applicable or available

Table 6-4c—Current and Residual Cancer Risks and Noncancer Hazard Quotients for Average Tribal Fishers due to Consumption of Fish and Shellfish from the Marine Sediments Unit of the PSR Superfund Site

			Residual Risk Following Cleanup to SQS								
	Residual Concentrations (µg/kg)		Fish			Shellfish			Total (Fish and Shellfish)		
			Lifetime	Adult	Child	Lifetime	Adult	Child	Lifetime	Adult	Child
Chemical	Fish Tissue	Shellfish Tissue	CR	HQ	HQ	CR	HQ	HQ	CR	HQ	HQ
Polycyclic Aromatic Hydrocarbons											
Benzo(g,h,i)perylene	N/A	12	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	N/A	38	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	N/A	67	NA	NA	NA	NA	0.0	0.0	NA	0.0	0.0
Total B(a)P equivalent	N/A	34	NA	NA	NA	1.3E-06	NA	NA	1.3E-06	NA	NA
Benzo(a)anthracene	N/A	25	*NA*	*NA*	*NA*	*9.8E-08*	*NA*	*NA*	*9.8E-08*	*NA*	*NA*
Chrysene	N/A	31	*NA*	*NA*	*NA*	*1.2E-09*	*NA*	*NA*	*1.2E-09*	*NA*	*NA*
Benzo(b)fluoranthene	N/A	28	*NA*	*NA*	*NA*	*1.1E-07*	*NA*	*NA*	*1.1E-07*	*NA*	*NA*
Benzo(k)fluoranthene	N/A	12	*NA*	*NA*	*NA*	*4.5E-09*	*NA*	*NA*	*4.5E-09*	*NA*	*NA*
Benzo(a)pyrene	N/A	24	*NA*	*NA*	*NA*	*9.5E-07*	*NA*	*NA*	*9.5E-07*	*NA*	*NA*
Indeno(1,2,3-cd)pyrene	N/A	12	*NA*	*NA*	*NA*	*4.7E-08*	*NA*	*NA*	*4.7E-08*	*NA*	*NA*
Dibenz(a,h)anthracene	N/A	3	*NA*	*NA*	*NA*	*1.2E-07*	*NA*	*NA*	*1.2E-07*	*NA*	*NA*
Dioxins/Furans											
Total 2,3,7,8-TCDD(Equiv)	0.001	0.000	1.5E-07	NA	NA	1.7E-07	NA	NA	3.2E-07	NA	NA
TOTAL PAH RISKS			*0.0E+00*	*0.0*	*0.0*	*1.3E-06*	*0.0*	*0.0*	*1.3E-06*	*0.0*	*0.0*
TOTAL DIOXIN RISKS			*1.5E-07*	*NA*	*NA*	*1.7E-07*	*NA*	*NA*	*3.2E-07*	*NA*	*NA*
TOTAL RISKS			**1.5E-07**	**0.0**	**0.0**	**1.5E-06**	**0.0**	**0.0**	**1.6E-06**	**0.0**	**0.0**

NA: Not applicable or available

Table 6-4d—Current and Residual Cancer Risks and Noncancer Hazard Quotients for Average Tribal Fishers due to Consumption of Fish and Shellfish from the Marine Sediments Unit of the PSR Superfund Site

	Residual Risk Following Risk-Based Cleanup										
	Residual Concentrations (µg/kg)		Fish			Shellfish			Total (Fish and Shellfish)		
			Lifetime	Adult	Child	Lifetime	Adult	Child	Lifetime	Adult	Child
Chemical	Fish Tissue	Shellfish Tissue	CR	HQ	HQ	CR	HQ	HQ	CR	HQ	HQ
Polycyclic Aromatic Hydrocarbons											
Benzo(g,h,i)perylene	N/A	12	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	N/A	39	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	N/A	69	NA	NA	NA	NA	0.0	0.0	NA	0.0	0.0
Total B(a)P equivalent	N/A	34	NA	NA	NA	1.3E-06	NA	NA	1.3E-06	NA	NA
Benzo(a)anthracene	N/A	26	*NA*	*NA*	*NA*	*1.0E-07*	*NA*	*NA*	*1.0E-07*	*NA*	*NA*
Chrysene	N/A	31	*NA*	*NA*	*NA*	*1.2E-09*	*NA*	*NA*	*1.2E-09*	*NA*	*NA*
Benzo(b)fluoranthene	N/A	27	*NA*	*NA*	*NA*	*1.0E-07*	*NA*	*NA*	*1.0E-07*	*NA*	*NA*
Benzo(k)fluoranthene	N/A	11	*NA*	*NA*	*NA*	*4.4E-09*	*NA*	*NA*	*4.4E-09*	*NA*	*NA*
Benzo(a)pyrene	N/A	25	*NA*	*NA*	*NA*	*9.5E-07*	*#N/A*	*NA*	*9.5E-07*	*NA*	*NA*
Indeno(1,2,3-cd)pyrene	N/A	12	*NA*	*NA*	*NA*	*4.7E-08*	*NA*	*NA*	*4.7E-08*	*NA*	*NA*
Dibenz(a,h)anthracene	N/A	3	*NA*	*NA*	*NA*	*1.2E-07*	*NA*	*NA*	*1.2E-07*	*NA*	*NA*
Dioxins/Furans											
Total 2,3,7,8-TCDD(Equiv)	0.001	0.000	1.1E-07	NA	NA	1.3E-07	NA	NA	2.3E-07	NA	NA
TOTAL PAH RISKS			*0.0E+00*	*0.0*	*0.0*	*1.3E-06*	*0.0*	*0.0*	*1.3E-06*	*0.0*	*0.0*
TOTAL DIOXIN RISKS			*1.1E-07*	*NA*	*NA*	*1.3E-07*	*NA*	*NA*	*2.3E-07*	*NA*	*NA*
TOTAL RISKS			**1.1E-07**	**0.0**	**0.0**	**1.5E-06**	**0.0**	**0.0**	**1.6E-06**	**0.0**	**0.0**

NA: Not applicable or available

Table 6-4e—Current and Residual Cancer Risks and Noncancer Hazard Quotients for Average Tribal Fishers due to Consumption of Fish and Shellfish from the Marine Sediments Unit of the PSR Superfund Site

Chemical	Residual Concentrations (µg/kg) Fish Tissue	Residual Concentrations (µg/kg) Shellfish Tissue	Residual Risk for Elliott Bay Background: Fish Lifetime CR	Fish Adult HQ	Fish Child HQ	Shellfish Lifetime CR	Shellfish Adult HQ	Shellfish Child HQ	Total (Fish and Shellfish) Lifetime CR	Total Adult HQ	Total Child HQ
Polycyclic Aromatic Hydrocarbons											
Benzo(g,h,i)perylene	N/A	6	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	N/A	7	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	N/A	21	NA	NA	NA	NA	0.0	0.0	NA	0.0	0.0
Total B(a)P equivalent	N/A	44	NA	NA	NA	1.7E-06	NA	NA	1.7E-06	NA	NA
Benzo(a)anthracene	N/A	26	*NA*	*NA*	*NA*	*1.0E-07*	*NA*	*NA*	*1.0E-07*	*NA*	*NA*
Chrysene	N/A	9	*NA*	*NA*	*NA*	*3.5E-10*	*NA*	*NA*	*3.5E-10*	*NA*	*NA*
Benzo(b)fluoranthene	N/A	15	*NA*	*NA*	*NA*	*5.8E-08*	*NA*	*NA*	*5.8E-08*	*NA*	*NA*
Benzo(k)fluoranthene	N/A	5	*NA*	*NA*	*NA*	*1.9E-09*	*NA*	*NA*	*1.9E-09*	*NA*	*NA*
Benzo(a)pyrene	N/A	11	*NA*	*NA*	*NA*	*4.2E-07*	*#N/A*	*NA*	*4.2E-07*	*NA*	*NA*
Indeno(1,2,3-cd)pyrene	N/A	6	*NA*	*NA*	*NA*	*2.2E-08*	*NA*	*NA*	*2.2E-08*	*NA*	*NA*
Dibenz(a,h)anthracene	N/A	26	*NA*	*NA*	*NA*	*1.0E-06*	*NA*	*NA*	*1.0E-06*	*NA*	*NA*
Dioxins/Furans											
Total 2,3,7,8-TCDD(Equiv)	0.001	0.000	9.7E-08	NA	NA	3.3E-08	NA	NA	1.3E-07	NA	NA
TOTAL PAH RISKS			*0.0E+00*	*0.0*	*0.0*	*1.7E-06*	*0.0*	*0.0*	*1.7E-06*	*0.0*	*0.0*
TOTAL DIOXIN RISKS			*9.7E-08*	*NA*	*NA*	*3.3E-08*	*NA*	*NA*	*1.3E-07*	*NA*	*NA*
TOTAL RISKS			**9.7E-08**	**0.0**	**0.0**	**1.7E-06**	**0.0**	**0.0**	**1.8E-06**	**0.0**	**0.0**

NA: Not applicable or available

SECTION 6 TABLES

Table 6-5—Summary of Uncertainties and Their Potential Impacts on Actual Risks Relative to Risk Estimates

Assumption	Alternate Possibility	Effect on Risk Estimate
Land Use		
Access to shoreline at site is restricted.	Access is available for fishing from pier or shoreline, or for general upland access to the shoreline.	↑
Fish and Shellfish Exposures		
Home range of English sole roughly limited to area of the PSR MSU.	English sole have significantly larger home range.	↓, ↑[1]
English sole were used to represent contaminant concentrations in all bottomfish consumed from the site.	Several different bottomfish from the site were used to represent contaminant concentrations in all bottomfish consumed from the site.	<
Human Exposure Assumptions		
A high-end tribal fishing scenario was chosen to represent RME subsistence fishing at the site.	An alternative subsistence fishing scenario was used to represent RME subsistence fishing at the site.	↑
Only the fillets of fish were assumed to be consumed from the site.	Additional parts of the fish, such as organs and skin, are commonly consumed by people at the site.	↑
A default exposure duration of 30 years was used to represent the amount of time over which a person subsists from the site.	A person gathers fish and shellfish from the site over a lifetime living in the area.	↑
An exposure frequency of approximately six months per year was used to represent the time during which subsistence users may gather and consume fish from the PSR site.	Fishing quotas are reached and/or supply of available fish is depleted in less than six months.	↓
100 percent of all bottomfish consumed from Puget Sound was procured from the site.	Only a fraction of bottomfish consumed are obtained from the site.	↓
100 percent of all mobile shellfish consumed from Puget Sound was obtained from the site.	The site is unable to provide 100 percent of mobile shellfish for a subsistence consumer (who must then obtain some shellfish off-site).	↓
Only crabs and shrimp were assumed to be among shellfish gathered from the site.	Changes in site conditions lead to increased access to and increased availability of sessile shellfish (e.g., clams).	↑

Table 6-5—Summary of Uncertainties and Their Potential Impacts on Actual Risks Relative to Risk Estimates

Assumption	Alternate Possibility	Effect on Risk Estimate
Subsistence consumers utilize only the PSR MSU to gather fish and shellfish during the open harvesting period.	Subsistence consumers utilize more than the one site to gather fish and shellfish during the open harvesting period at the PSR site.	↓
Exposure Point Concentrations		
Clam and fish tissue exposure point concentrations were based on a bioaccumulative modeling approach.	Fish and shellfish consumed from the site have different lipid content and/or bioaccumulate contaminants at different rates than those organisms on which bioaccumulative modeling parameter values (e.g., f_{lipid} or BSAF) were based.	∢, ↓
Arithmetic mean was used as basis for calculating exposure point concentrations.	Distribution of contaminant concentrations is lognormal.	↓
Contaminant concentrations were assumed to remain constant over the exposure duration.	Contaminant concentrations decrease over time due to mixing, sedimentation, biodegradation, etc.	↓
Nondetects were represented using one half the detection limit.	Nondetect concentrations were known with greater precision.	∢
Contaminants in fish and shellfish were assumed to be 100 percent bioavailable to people.	Contaminants in fish and shellfish are less than 100 percent bioavailable to people.	↓
Unavailable Toxicity Factors		
A toxicity equivalency factor approach was used to estimate toxicity from carcinogenic PAHs and from dioxins/furans.	Each individual chemical had an individual toxicity factor available.	∢
Four PAHs did not have any toxicity factors available.	Toxicity factors were available for these compounds.	↑
Noncancer hazards were based on a single PAH (pyrene, the only COPC with available RfD).	RfDs were available for additional PAHs or other COPCs	↑
Derivation of Toxicity Factors		
Each RfD and CSF is developed under several assumptions and with inherent uncertainties.	RfD and CSF inputs were known with greater precision.	∢

∢ Risk may increase or decrease if alternative case replaced assumption.
↑ Risk would increase if alternative case replaced assumption.
↓ Risk would decrease if alternative case replaced assumption.
[1] Risk estimates for current conditions would decrease, but residual risk estimates would likely increase.

SECTION 7

ECOLOGICAL RISK CHARACTERIZATION AND UNCERTAINTIES

In risk characterization, estimated exposures (predicted in the Exposure Assessment, **Section 4**) are compared to acceptable exposure benchmark values (identified in the Toxicity Assessment, **Section 5**). When predicted exposures exceed benchmark values there is potential risk for ecological receptors.

Risks for ecological receptors inhabiting or using the MSU were evaluated both quantitatively (e.g., sediment chemical concentrations) and qualitatively (e.g., benthic diversity). Quantitative risk was expressed as either a hazard quotient (HQ), which represents the risk associated with a single contaminant at a single station or as a hazard index (HI), which is the sum of more than one HQ. HIs represent the risk associated with several chemicals and/or several stations. In contrast, qualitative risks were expressed in a descriptive manner, based on statistical comparisons to background areas.

As identified in the Exposure Assessment, several ecological receptors were evaluated for their potential to incur adverse effects following exposure to contaminated sediments in the MSU. The ecological receptors evaluated were divided into two categories: benthic invertebrates and bottom fish. Risks for benthic invertebrates and bottom fish under current exposure conditions are characterized below in **Sections 7.1** and **7.2**, respectively. **Section 7.3** integrates the results of the benthic invertebrate and bottom fish risk characterizations into an overall picture of current risk to ecological receptors. **Section 7.4** identifies the residual risks for ecological receptors associated with implementation of the different cleanup options identified in **Section 1**; and **Section 7.5** discusses the uncertainties associated with the predicted risks.

7.1 BENTHIC RISK CHARACTERIZATION

Potential risks to benthic invertebrates were characterized using a preponderance of evidence approach. In this approach, several different measurements based on chemical concentrations in surface sediment, laboratory bioassay data, and benthic community structure were used to predict overall potential toxicity to the benthic community at nine locations within the MSU. Specifically, sediment chemical concentrations were compared to effects-based chemical criteria to identify the potential for toxicity to benthic organisms; amphipod, echinoderm, and clam laboratory bioassays were used to provide direct measures of sediment acute and chronic toxicity; and benthic infaunal community data were used to provide an *in situ* measure of potential toxicity associated with chronic exposure to sediment contaminants. In addition, clam bioaccumulation studies were used as indicators of the potential bioavailability of certain sediment contaminants, and the degree to which those contaminants may accumulate in benthic organisms exposed to the MSU relative to background areas. The results of these measurements, including an overall assessment of potential risk to the benthic community, are presented below.

7.1.1 Sediment

A complete listing of surface sediment chemical data for the nine MSU and the four background area sampling locations (BK01, BK02, BK03, and BK04) was provided in the RI Report (WESTON 1998) and **Attachment K.9** (background only). The sediment measurements used in the risk characterization include comparisons of sediment chemical concentrations to both effects-based screening criteria and to average Elliott Bay background sediment concentrations.

7.1.1.1 Comparisons with Effects-Based Screening Criteria

Two sets of effects-based screening criteria were used as predictors of potential sediment toxicity; SMS SQS chemical criteria and SMS CSL chemical criteria. SMS SQS chemical criteria represent concentrations above which *minor to moderate* deleterious biological effects are predicted to occur in benthic communities, while SMS CSL chemical criteria represent concentrations above which *moderate to severe* biological effects may occur.

Stations at which chemicals were detected in surface sediment samples at concentrations exceeding SQS chemical criteria (or LAET screening values, where applicable; see **Section 3.2**) were identified as locations potentially associated with adverse benthic effects. SQS/LAET sediment hazard quotients (HQs) were then calculated for each individual chemical at a given station by dividing the measured sediment concentration by its SQS or LAET chemical criterion. Individual sediment chemical HQs greater than one were summed and averaged for each station and each chemical to obtain station- and chemical-specific total and average hazard indices (HIs) for use in the benthic risk evaluations.

Chemical exceedances of the SMS CSL chemical criteria (or 2LAET screening values, where applicable; see **Section 3.2**) were also used in the interpretation of the benthic data as a measure of potential magnitude of impact. As a result, CSL/2LAET sediment HQs were calculated for each individual contaminant at a given station by dividing the measured sediment concentration by its CSL or 2LAET chemical criterion. The resulting HQs greater than one were summed and averaged for each station and each chemical to obtain station- and chemical-specific total and average HIs for benthic risk evaluations.

Contaminants of concern were present at each of the nine MSU stations at concentrations exceeding effects-based chemical criteria; individual HQs and cumulative HIs derived from comparisons with SQS/LAET and CSL/2LAET chemical criteria that exceeded 1.0 are summarized by station and analyte in **Tables 7-1** and **7-2**, respectively.

The sampling locations exhibiting the highest total and average station-specific HIs were stations EB87 and EB104, which are located farthest offshore to the northeast of the former upland facility. Both stations were characterized by multiple individual (and total) PAH exceedances of

SQS/LAET chemical criteria, with average station-specific SQS/LAET HIs between 6 and 8. The concentrations of LPAHs measured at these stations also exceeded CSL/2LAET chemical criteria, resulting in average station-specific CSL/2LAET HIs between 4 and 6.

7.1.1.2 Comparisons with Elliott Bay Background Concentrations

Comparison of COPCs (i.e., PAHs, and 2,3,7,8-TCDD equivalents) at nine site locations to average Elliott Bay surface sediment background (BK01, BK02, BK03 and BK04) concentrations was also conducted for use in the interpretation of the clam tissue bioaccumulation data. The methods for deriving background concentrations were described in detail in **Section 3**. Background exceedance ratios (ERs) were calculated for each of the clam COPCs in sediment at each station by dividing the measured MSU concentration by the average background concentration. Similar to the approach described above, individual ERs greater than one were summed and averaged for each station and each bioaccumulative COPC to obtain station- and chemical-specific total and average background ERs.

All groups of bioaccumulative COPCs (i.e., PAHs, and 2,3,7,8-TCDD equivalents) were present at the nine MSU stations at concentrations exceeding average Elliott Bay background concentrations (**Table 7-3**). Individual PAHs (particularly LPAHs) exhibited some of the highest chemical-specific exceedances of Elliott Bay background concentration. Naphthalene had an average ER of 106, while acenaphthene and fluorene were elevated 39 and 38 (respectively) times above background over all 9 stations. Anthracene also exhibited one of the highest average exceedance ratios, with an ER of 17. All other individual PAH average ERs were lower, ranging from about 3 to 11. 2,3,7,8-TCDD equivalents exhibited an average chemical-specific ER of 10.2.

The stations exhibiting the highest total and average station-specific ERs were EB87, EB104, EB80, and EB85, all of which exhibited average station-specific ERs greater than 10.0 (ranging from 11 to 45).

7.1.2 Laboratory Bioassays

A complete set of all laboratory bioassay data, including replicate-specific results, are provided in **Attachment K.6**. The reports describing the detailed validation of these data are provided in the **Appendix E** of the RI.

The results for the MSU bioassays were reviewed in detail by WESTON and were determined to be valid and generally of high quality. However, all background sediments (i.e., those from both the Carr Inlet and Elliott Bay background stations) tested for the amphipod and echinoderm acute bioassays failed to meet the background sediment performance criteria specified in the SMS. The reasons for these failures were unclear (see the bioassay data validation reports presented in WESTON 1997). The results of the control sediments, which met all specified performance standards, were subsequently substituted for reference in the statistical comparisons, per current Ecology guidance.

The laboratory bioassays used in the risk characterization include amphipod, echinoderm larvae, and clam bioassays. Results of these bioassays are presented below.

7.1.2.1 Amphipods

7.1.2.1.1 Differences Among MSU and Control Results

The mean percent mortality for amphipods exposed to laboratory control sediments was 9 percent; mean percent mortality results for amphipods exposed to the MSU ranged from 28 to 72 percent (**Table 7-4**). The statistical analysis of these data indicate that all PSR stations exceeded the SQS biological criterion, based on significantly ($P \leq 0.05$) elevated mortalities relative to control and greater than 25 percent mortality. All but two of these stations (EB49 and EB106) also exceeded the CSL biological criterion for amphipod mortality (significantly different from reference and greater than 30 percent above reference mortality). Highest average mortality results (greater than 60 percent) occurred at stations EB60 and EB87, located offshore of the western portion of the PSR upland property and offshore of the Lockheed property east of the site, respectively. Complete statistical results are presented in **Attachment K.5**.

7.1.2.1.2 Correlation Analysis Results

The amphipod bioassay results do not appear to serve as a reliable indicator of the potential for sediment PAH associated toxicity, based on a correlation analysis between bioassay responses and chemical concentrations.

Amphipod mortality was not strongly correlated ($r<0.7$) with any of the sediment conventional or contaminant concentration data. In some cases, stations characterized by multiple sediment chemical exceedances of CSL or 2LAET chemical criteria exhibited lower percent mortality than stations characterized by lower concentrations of sediment contaminants, and vice versa. Complete correlation results are presented in **Attachment K.5**.

7.1.2.2 Echinoderm Larvae

7.1.2.2.1 Differences Among MSU and Control Results

Mortality in echinoderm larvae is measured in terms of *effective mortality*. Effective mortality is the combined measure of both the number of overt deaths and the number of individuals with abnormalities, which will lead to death. The mean percent effective mortality for echinoderm larvae exposed to laboratory control sediments was 0 percent (by default); average percent effective mortality results for larvae exposed to the MSU ranged from 10 to 49 percent (**Table 7-4**). Statistical analysis of these data indicate that six of the nine PSR stations exceeded the SQS biological criterion, based on significantly ($P \leq 0.10$) elevated effective mortalities relative to control. Of the six stations exceeding the SQS biological criterion, all but two (EB80 and EB106) also exceeded the CSL biological criterion for echinoderm larval effective mortality. Highest average effective mortality results (greater than 30 percent) occurred at stations EB85, EB87, and EB104, all of which are located offshore of the eastern portion of the PSR upland property and the Lockheed property. Complete statistical results are presented in **Attachment K.5**.

7.1.2.2.2 Correlation Analysis Results

The presence of strong, positive correlations between echinoderm effective mortality responses and sediment concentrations of PAHs, particularly the majority of LPAHs, suggests that the echinoderm bioassay results serve as a relatively reliable indicator of potential sediment toxicity. Echinoderm mortality was strongly correlated ($r>0.7$) with the following sediment contaminants of concern:

- All individual LPAHs except acenaphthylene
- Total LPAHs
- Three individual HPAHs (benzo[a]anthracene, fluoranthene, and pyrene)
- Total HPAHs

In most cases, highest larval effective mortality responses occurred at stations exhibiting the highest concentrations of PAHs, and lowest effective mortality responses were observed at stations with few to no sediment chemical exceedances of effects-based criteria. Complete results are presented in **Attachment K.5**.

7.1.2.3 Clams

The mean percent mortality for clams exposed to laboratory control sediments was 2 percent; average percent mortality results for clams exposed to sediments collected from the MSU ranged from 0 to 2 percent (**Table 7-5**). On an absolute basis, none of the mortality results exceeded the screening criterion for adverse effects. As a result, no statistical testing of site data versus controls was required.

Similar results were observed for the clam growth rate data: on an absolute basis, none of the growth rate results exceeded the screening criterion for adverse effects. The mean growth rate for clams exposed to laboratory control sediments was -0.005 mg/ind-day; average growth rates for clams exposed to the MSU ranged from no growth to -0.005 mg/ind-day (**Table 7-5**).

There was also no apparent association between tissue concentrations of contaminants and relative growth rate. Therefore, these clam bioassay data appear to have limited utility for assessing potential toxicity to benthic organisms following uptake of bioaccumulative contaminants from sediment. However, the tissue burden results were retained for evaluation of the degree of exposure sessile invertebrates may receive from the site (see **Section 7.1.4**).

7.1.2.4 Summary of Laboratory Bioassay Results

The echinoderm embryo bioassay provided the best indicator of potential PAH toxicity, based on the strong degree of association between the observed larval responses and the magnitude of sediment chemical contamination. In contrast, the amphipod bioassay results appear to be less reliable with respect to interpreting potential PAH toxicity.

The clam bioassay data do not suggest sublethal impacts associated with uptake of contaminants of concern by benthic organisms exposed to the MSU. However, the growth data appear to be of limited utility in assessing sediment toxicity based on the apparent lack of association among the growth rate responses relative to tissue and co-located sediment contaminant concentrations.

Overall, results of the echinoderm bioassays suggest that exposure to site sediments may elicit acute toxic responses in benthic infaunal organisms under current conditions; however, higher toxicity appears to be limited to areas north and northeast of the former upland facility (i.e., stations EB77, EB80, EB85, EB87, and EB104).

7.1.3 Benthic Infauna

Benthic infauna analysis provides an evaluation of the *in situ* health of the benthic community. The analysis includes evaluations of descriptive biological indices (i.e., abundance, richness, major taxa abundance, major taxa group richness, diversity, community composition, and presence of pollution-tolerant and –sensitive taxa) and a comparison of site results to conditions at background station BK04. Comparisons to the potential background station BK01 were not made, due to the lack of similarity in habitat characteristics. Results from site stations that were similar to background station characteristics were considered indicative of a healthy benthic community. The outcome of these evaluations is presented below.

The complete set of benthic infaunal data, including species-level data for each replicate, is provided in **Attachment K.1**. The results of the benthic enumeration and identification analysis were reviewed in detail by WESTON and the data were determined to be of high quality and acceptable for use in the benthic risk evaluation (see **Appendix E** of the RI).

7.1.3.1 Descriptive Biological Indices

The health of the benthic invertebrate community inhabiting the MSU was evaluated using a series of descriptive indices including total abundance, richness, major taxa group abundance and richness, Swartz's dominance index (SDI), community composition based on numerically dominant taxa, and the relative abundance and richness of pollution-tolerant and -sensitive taxa. Station and sample characteristics based on these indices are described below.

7.1.3.1.1 Abundance

Abundance (number of individuals) data for each sample collected from the nine MSU stations and two Elliott Bay background stations are presented in **Table 7-6**. The average abundance, expressed as the mean number of individuals per 0.1 m^2, among MSU stations ranged from 729 individuals at Station EB106, located northwest of the West Slip, to 1,491 individuals at Station EB60, located offshore of Station EB106. None of the average total abundance values was below the average abundance observed at the benthic background station (BK04), which was represented by 726 individuals.

7.1.3.1.2 Richness

Richness (number of taxa) data for each sample collected from the nine MSU stations and two Elliott Bay background stations are presented in **Table 7-6**. Mean richness among the PSR MSU stations ranged from 77 to 112 taxa. The average richness values for five stations (EB60, EB67, EB80, EB85, and EB106) were slightly below the average richness value observed at the background station (88 taxa), ranging from 77 to 86 taxa.

7.1.3.1.3 Major Taxa Abundances

In a healthy benthic infaunal community, all major taxa groups tend to be equitably represented, without excessive dominance by a single group (particularly polychaetes). For the MSU stations with benthic data, all major taxa groups were present.

Major taxonomic group (crustaceans, molluscs, polychaetes, and miscellaneous taxa) abundance data are summarized in **Table 7-7**. Molluscs were generally the most abundant taxonomic group at the MSU stations. The relative total abundance of molluscs at all but one MSU station (EB87) exceeded the relative total abundance of molluscs at the benthic background station.

Polychaetes generally represented the next most abundant major taxonomic group at the MSU stations. The relative total abundances of polychaetes at all but two MSU stations (EB87 and EB106) were lower than the relative total abundance of polychaetes at the benthic background station. In addition, polychaetes accounted for more than half the infauna at Station EB87, which may be considered indicative of some stress to the community.

The relative total abundances of crustaceans at the MSU stations were generally slightly greater than the relative total abundance of crustaceans measured at the benthic background station.

Miscellaneous taxa represented only 1 to 5 percent of the total abundance of organisms at the site stations, and represented a slightly greater proportion (9 percent) of the total abundance at the benthic background station.

7.1.3.1.4 Major Taxa Group Richness

In general, the distribution of species among major taxonomic groups was similar to that found at the background station.

Major taxonomic group (crustaceans, molluscs, polychaetes, and miscellaneous taxa) richness data are summarized in **Table 7-8**. Polychaetes were the most diverse taxonomic group at the MSU stations, with the total number of unique taxa ranging from 84 to 119 species. The total number of unique polychaete taxa at all MSU stations except EB67 and EB87 (84 species each) exceeded the total polychaete richness for the benthic background station (86 taxa) by 3 to 33 species.

The diversity of molluscs and crustaceans at the MSU stations was similar, with molluscs represented by a total of 25 to 34 unique species and crustaceans represented by a total of 19 to 50 unique taxa. The total numbers of unique species of crustaceans and molluscs at the benthic background location was 30 and 34 taxa, respectively.

Miscellaneous taxa were the least diverse group among the MSU stations, represented by a total richness of 7 to 13 taxa. The number of unique miscellaneous taxa observed at the benthic background station was similar, at a total of 11 species.

7.1.3.1.5 Dominance

SDI values are summarized in **Table 7-9**. SDI values for the MSU stations ranged from 5.55 to 18.16 with the lowest values measured at stations EB80 and EB85. All MSU values were lower than the SDI value calculated for the benthic background station (19.29), which indicates alterations in the community are occurring; however, none of the site values was less than 5.0, which is typically used to indicate severely stressed communities.

7.1.3.1.6 Community Composition Based on Numerically Abundant Taxa

Compilation of the top ten numerically abundant taxa at each site and background station resulted in a matrix represented by a total of 25 species (**Table 7-9**). All but one of the top ten taxa at the background station were shared among the dominant taxa arrays at the MSU stations, indicating a high degree of similarity between site stations and the background station.

7.1.3.1.7 Pollution-Tolerant and -Sensitive Taxa

The relative abundance and richness of pollution-tolerant and -sensitive taxa at each MSU and background station is presented in **Table 7-10**. Pollution-tolerant taxa represented from 35 to 66 percent of the total abundance of organisms at the MSU stations. Each of the MSU stations was characterized by a substantially higher relative abundance of pollution- and organic enrichment-tolerant taxa than the background station, at which pollution-tolerant taxa accounted for 32 percent of the total station abundance. Greater proportions of pollution tolerant species may indicate the community is responding to alterations in their environment caused by increased loading of organic contaminants.

Taxa considered to be sensitive to contaminants were present at each of the MSU stations at low levels, accounting for between 2 and 8 percent of the total station abundances. In contrast, pollution-sensitive taxa represented 20 percent of the total station abundance at the background location.

Comparisons of relative richness among the MSU Stations and the background station indicated a similar diversity of pollution-tolerant and -sensitive taxa among the stations. However, the abundances of sensitive taxa at the MSU stations are reduced relative to background, suggesting some degree of adverse response or impact to the benthic community may be occurring at all locations sampled as a result of exposure to contaminated sediments.

7.1.3.2 Differences among MSU and Background Station

As described in **Section 5.2.4**, relationships among stations based on richness, total abundance, and major taxa abundance and richness were examined using analysis of variance techniques (i.e., two-sample t-tests and multiple-comparison ANOVAs). In addition, similarities in community structure among MSU and background stations were examined using classification analysis. Complete results of these statistical analyses are presented in **Attachment K.5**.

7.1.3.2.1 Pair-Wise Comparison Results

The t-tests using total abundance and richness and major taxa group abundance and richness for the MSU stations indicated that significant differences among site stations were present, with some general trends. Results are summarized in **Table 7-11** and noted as part of **Table 7-6** through **7-8**.

The t-tests comparing MSU stations with the background indicated statistically significant differences between the site and background for the abundance and richness data. Specifically, the background station exhibited significantly lower total abundance and crustacean abundance than all but two of the MSU stations. Mollusc abundance, mean richness, polychaete abundance and richness, and crustacean richness at the background station was also significantly lower than most of the site stations. In contrast, the abundance of miscellaneous taxa was significantly higher at the background station than at nearly half of the MSU stations, as was mollusc richness.

7.1.3.2.2 Classification Analysis Results

As described in **Section 5.2.4** and **Attachment K.4**, classification (cluster) analyses were conducted to determine the degree of similarity among stations. Results of the classification analyses are presented in **Table 7-12** and **Figure 7-1**.

The degree of similarity among stations was high, with all of the MSU stations and the background station linked at a similarity of 61 percent. The four shallowest stations in the MSU (EB49, EB87, EB106, and EB104), ranging in depth from approximately -12 to -32 ft MLLW, formed one cluster with a similarity of greater than 65 percent. The five remaining MSU stations (EB60, EB67, EB77, EB80, and EB85), located at depths between approximately -34 and -60 ft MLLW, formed a separate group with a similarity of greater than 75 percent, and clustered with the background station at a similarity of 72 percent.

7.1.3.3 Correlation Analysis Results

Benthic abundance and richness endpoints were strongly correlated ($r>0.7$) with only a few sediment conventional and contaminant data, as follows:

- Total abundance was negatively correlated with percent fines and positively correlated with percent sand.
- Total richness was positively correlated with anthracene, benzo(a)anthracene, pyrene, and total HPAHs .
- Crustacean abundance was negatively correlated with percent fines and positively correlated with percent sand.
- Mollusc abundance was negatively correlated with total benzofluoranthenes and benzo(a)pyrene
- Polychaete abundance was positively correlated with anthracene.

Complete correlation results are presented in **Attachment K.5**.

The positive associations between polychaete abundance and total richness (which were together correlated with a coefficient of 0.93) and individual PAHs would not typically be anticipated, as it would be expected that as chemical concentrations increased, benthic invertebrate abundance and diversity would decrease. However, polychaetes may be able to utilize some organic chemicals as food, and would then tend to exhibit a positive correlation with chemicals such as PAHs.

7.1.4 Clam Bioaccumulation

As discussed in **Section 7.1.2.3**, sublethal effects (i.e., significantly reduced growth relative to background) were not observed in the clams exposed to the MSU and the organisms exhibited a very limited range of responses relative to their highly variable tissue and test sediment contaminant concentrations, suggesting limited association among the endpoints. Although these data indicate that exposure to site-related chemicals may be occurring, these data were of limited utility in evaluating potential toxicity associated with the contaminants of concern in the clam tissues. In lieu of conducting comparisons with effects-based data, which are not available in the literature, the concentrations of chemicals measured in these whole body clam tissues were compared with average chemical concentrations measured in whole body tissues of clams exposed to Elliott Bay background sediment. Exceedance of background does not imply that toxic effects are occurring. However, an exceedance of background was used as a measure of exposure, with a concomitant likelihood for increased impacts.

7.1.4.1 Comparisons with Elliott Bay Background Tissue Concentrations

Prior to conducting the comparisons of site-related and background area data, the clam tissue data were subjected to the procedures described in **Section 3.5.2** for deriving lipid-normalized tissue concentrations, compound totals, and 2,3,7,8-TCDD (equivalent) concentrations. The procedures followed to derive the background screening concentrations used in these comparisons were also described in **Section 3**.

ERs based on comparisons with background were calculated for each individual chemical at a given station by dividing the MSU clam tissue concentration by the average background concentration. Individual clam tissue chemical ERs greater than one were then summed and averaged for each station and each chemical to obtain station- and chemical-specific total and average background ERs for use in the benthic risk evaluations.

COPCs were present in whole body tissues of clams exposed to sediment collected from each of the nine MSU stations at concentrations exceeding average Elliott Bay background concentrations; ERs derived based on these comparisons and exceeding 1.0 are summarized by station and analyte in **Table 7-13**.

The stations exhibiting the highest total and average station-specific ERs were EB67, EB87, and EB104, located north and northeast of the former upland facility. The average station-specific background ERs for these locations ranged between 12 and 43. In contrast, average station-specific background ERs for all other MSU stations were less than 7.

7.1.4.2 Correlation Analysis Results

Clam tissue contaminant concentrations were strongly correlated ($r>0.7$) with test sediment concentrations of the following chemicals:

- Total LPAHs
- Four individual HPAHs (pyrene, chrysene, total benzofluoranthenes, benzo[a]pyrene)
- Total HPAHs
- 2,3,7,8-TCDD (equivalents)

The presence of strong, positive correlations among the clam tissue and sediment chemical concentrations suggests that exposures to site-related sediment may occur in benthic infauna, as contaminants in the sediment appear to be available for uptake by sediment-dwelling organisms. However, the potential for sublethal effects associated with contaminant uptake is unknown. The limited range of responses for the mortality and growth rate tests using these clams did not support the identification of an effects threshold.

7.2 FISH RISK CHARACTERIZATION

In contrast to the preponderance of evidence approach used to estimate risks to benthic invertebrates, risks to the bottom fish community were assessed using point risk estimates for adult/juvenile fish and fish eggs/fry. A preponderance of evidence approach was not used due to the limited measurements available to assess risks to the fish community. Prediction of risk to the fish community relied on comparison of modeled exposures and measured fish (English sole) tissue values to effects-based values found in literature, as opposed to the *in situ* measurements used for benthic invertebrates.

Risks to the bottom fish community were assessed for dioxins and furans (expressed as 2,3,7,8-TCDD equivalents) based on the following criteria (WESTON 1996a,b; 1997a):

- Potential of these contaminants to cause adverse chronic effects to the benthic fish community.
- Ability of these contaminants to bioaccumulate in vertebrate fish and higher orders of animals up the aquatic food chain.
- Ability of these contaminants to be accumulated in the eggs of gravid females through a maternal transfer process.

7.2.1 Approach

Risks to fish and their eggs are expressed in quantitative terms for individual contaminants—based on whole body fish or egg tissue concentrations exceeding their respective fish or egg effects ranges—called the hazard quotient (HQ). The HQ is represented by the following equation:

(1) FISH

$$HQ_{\text{FISH}} = \frac{[\text{MSUFISH}]}{[\text{EFFECTS}]}$$

Where:

MSUFISH = Concentration of 2,3,7,8-TCDD equivalent measured in MSU English sole.

EFFECTS = 2,3,7,8-TCDD equivalent effects range for English sole.

(2) EGG

$$HQ_{EGG} = \frac{[MSUEGG]}{[EFFECTS]}$$

Where:

MSUEGG = Concentration of 2,3,7,8-TCDD equivalents estimated in MSU English sole eggs.

EFFECTS = 2,3,7,8-TCDD equivalent effects range for egg of English sole.

7.2.2 Summary of Fish Risk Results

Risk results (i.e., HQs) for fish and eggs are provided in **Tables 7-4** and **7-5** and Attachment K.3.

No hazard values associated with exposure to 2,3,7,8-TCDD equivalents (i.e., HQs) were calculated above 1.0, which is the value above which potential impacts may occur (Menzie 1992).

7.2.3 Fish Risk Conclusions

The results of the bottom fish risk characterization indicate that adverse effects are not expected to occur in adult/juvenile fish or fish fry/eggs exposed to 2,3,7,8-TCDD equivalents in the MSU.

7.3 CURRENT RISK TO ECOLOGICAL RECEPTORS

The overall picture of risk to ecological receptors (i.e., benthic invertebrates and bottom fish) indicates that there is predicted risk for adverse impact to benthic invertebrates from exposure to all sediment-bound contaminants at each of the nine MSU stations and no predicted risk from bioaccumulative contaminants (specifically dioxins and furans) for the bottom fish community sharing the same area.

The results of the *in situ* benthic community analysis indicated that exposure to PAH contaminants in the MSU may elicit chronic adverse responses in infaunal organisms at all stations under current conditions; however, the degree of response does not appear to be severe in any of the sampled areas.

The majority of the stations sampled were characterized by abundant and diverse communities that exhibited a relatively high degree of similarity among themselves as well as with the background station. The average total abundance of organisms at each MSU station was higher than the average total abundance measured at the background station, and the total number of unique taxa sampled at each station within the MSU was similar to or greater than the number of unique species observed at the background station. All MSU stations exhibited SDI values greater than the value below which severely stressed communities are indicated. The analysis of community structure demonstrated that all MSU stations clustered with the background station with a relatively high degree of similarity. Based on these indices, the benthic community inhabiting the MSU would be considered healthy.

However, the reduced abundances of taxa considered to be sensitive to contaminant exposures at MSU stations relative to background suggested that some low- to moderate-level impacts may be occurring at all site stations. Numerically dominant taxa shared among these stations included several species considered to be tolerant of contaminated or organically-enriched sediments. Furthermore, moderate impacts to the benthic community were suggested at Stations EB80, EB85, EB87, and EB104, based on endpoints such as reduced abundances of miscellaneous taxa relative to background, reduced total richness relative to background, SDI values only slightly greater than 5.0, and enhanced polychaete abundances relative to background and other MSU stations.

Results of the sediment chemical evaluations suggest the potential for adverse impact to benthic receptors exposed to contaminated sediments in the vicinity of each of the nine MSU stations evaluated (**Tables 7-16** and **7-17**) under current conditions. The clam and fish tissue data, in conjunction with the sediment chemical data, further suggest that sediment-related contaminants are bioavailable to benthic organisms and are accumulating to a higher degree in MSU receptors than in organisms exposed to sediments at the background stations in Elliott Bay, but the potential toxicity associated with the levels of accumulation observed is uncertain. Review of these data in light of the laboratory toxicity data and *in situ* benthic results suggested that such exposures elicit only minor to moderate acute and/or chronic toxic responses, with moderate toxic effects limited primarily to stations north and northeast of the former upland facility.

Of the nine stations evaluated, the preponderance of evidence suggests that exposure to sediments in the vicinity of Stations EB87 and EB104 elicits severe acute and moderate chronic toxic responses in benthic receptors (**Tables 7-16** and **7-17**). Highest effective mortality in echinoderm embryos occurred at these two stations, which were also characterized by the highest concentrations of sediment contaminants relative to effects-based screening criteria. These two stations, located northeast of the former upland facility, were also characterized by enhanced abundances of polychaetes relative to the benthic background station. The enhancement of this taxonomic group may be due, in part, to differences in habitat relative to background, as sediments at these two MSU locations contained substantial amounts of wood fragments. Stations EB87 and EB104 also exhibited two of the three highest average station-specific background ERs for clam tissues, with ERs for bioaccumulative contaminants of concern of 12.5 (EB87) and 43.2 (EB104). Based on these data, Stations EB87 and EB104 were considered overall to be moderately impacted. An overall rating of severely impacted was not warranted based on the relatively high abundance and diversity of taxa present, as well as the presence of taxa considered to be sensitive to contaminant exposures at these locations.

Exposure to surface sediments in the vicinity of Stations EB80 and EB85 may also elicit acute and chronic adverse responses, but not to the degree observed at Stations EB87 and EB104 (**Tables 7-16** and **7-17**). Significantly elevated echinoderm mortality was observed at these two stations, but only the response at Station EB85 exceeded the CSL biological criterion. These two stations, located offshore of EB87 and EB104, were also characterized by relatively high average station-specific SQS/LAET HIs (4.6 and 4.7, respectively), but these HIs decreased by a factor of 2 when calculated based on comparisons with CSL/2LAET chemical criteria. Furthermore, the average station background ERs for clam tissues from these stations were among the three lowest ERs observed, at 3.7 (EB80) and 5.0 (EB85). The abundances of miscellaneous taxa at these two stations were depressed relative to background, but polychaete abundances were not enhanced, even in the presence of the wood fragments observed at these two locations. Based on these data, it appears that overall, Stations EB80 and EB85 are minimally to moderately impacted. Similar to Stations EB87 and EB104, an overall rating of severely impacted was not warranted given the abundance and diversity of the sampled communities, and the presence of pollution-sensitive taxa.

Exposure to sediment in the vicinity of Stations EB77 and EB67 may also pose risks to benthic receptors, although current impacts appear to be minimal (**Tables 7-16** and **7-17**). Sediments collected in the vicinity of Station EB77 appear to be associated with minimal adverse chronic effects but do not appear to elicit acute toxic responses. The echinoderm embryo bioassay results for this station were not significantly elevated relative to control, but the abundance of miscellaneous taxa was significantly reduced relative to background. In addition, the abundance of polychaetes was significantly enhanced relative to background based on *t*-test and, like all other site stations, the relative abundance of pollution-tolerant taxa was elevated in comparison with background.

Both acute toxicity and chronic effects were evidenced at Station EB67. This station was characterized by multiple sediment chemical exceedances of SQS/LAET criteria, with an average station-specific SQS/LAET HI of 1.9, but only two CSL/2LAET sediment chemical exceedances. The strong correlations observed among the echinoderm embryo toxicity tests responses and sediment chemical concentrations suggests that the acute toxicity observed in embryos exposed to sediment from this location may have been associated with these elevated sediment chemical concentrations. Furthermore, the *in situ* benthic data were suggestive of minor chronic impacts to receptors exposed to sediments in this portion of the MSU, based on the relative abundance of pollution-tolerant taxa. The clam tissue data were also suggestive of a high degree of bioavailability of sediment-related contaminants, as evidenced by the average station background ER of 14.3, which was the second-highest station-specific clam tissue ER observed.

Stations EB49, EB60, and EB106 also appear to represent minimally-impacted communities, but to a lesser degree than Stations EB67 and EB77 (**Tables 7-16** and **7-17**). Acute toxicity was not indicated by the echinoderm embryo test results, as the observed responses did not exceed the SQS biological criterion at any of the three stations, average sediment chemical concentrations were less than two times SQS/LAET chemical criteria, and significant reductions in major taxa group abundance and total abundance and richness relative to background were not observed among the benthic endpoints. Minimal impacts were considered to be occurring, however, based on the elevated abundances of pollution-tolerant taxa relative to background. In addition, sediment-related contaminants at these stations appear to be bioavailable, as they were detected in clam tissues at concentrations exceeding average Elliott Bay background values by factors of 5 to 7.

7.4 RESIDUAL ECOLOGICAL RISKS

Residual risks to benthic infaunal invertebrates were derived as part of the ecological risk assessment. Residual risks were based on assumptions of different cleanup areas (see **Section 3**) defined based on SMS criteria. A summary of residual risks to ecological receptors is provided in **Table 7-18** and discussed in the following text. No residual risk was evaluated for exposure of fish to dioxins because current conditions suggest no impacts are occurring.

7.4.1 Benthic Invertebrates

Current conditions of the benthic infaunal community indicate a potential for risk at each of the nine stations sampled, based on the sediment chemical, toxicity, and invertebrate community data (see **Table 7-18**). Of these nine stations, only three appear to represent moderate risks; however, seven of these stations would be reduced to no risk if the cleanup to CSLs was implemented (average concentrations within the CSL cleanup area will be equivalent to background following cleanup). The remaining two stations associated with low level impacts would also be reduced to no risk following successive cleanup to SQS levels.

Bioaccumulation of PAHs in clams above background levels indicates that exposure can occur and the potential for deleterious impacts exists under current conditions. Incremental cleanups result in a reduction in the number of stations exceeding background as shown in **Table 7-18**. Evaluation of extrapolated clam tissue concentrations (see **Table 4-6**) used in the human health assessment suggested that cleanup of areas exceeding PAH CSLs would result in clam tissue concentrations approaching Elliott Bay background.

7.4.2 Bottom Fish

Current conditions indicate an absence of potential impacts to fish or fish eggs from TCDD exposure. Additional reductions in risk resulting from different cleanup options was therefore not evaluated. Of note, site-wide average sediment concentrations will be reduced to below SQS/LAET levels following cleanup to CSLs, which should improve the health of the fish community relative to contaminant effects not addressed by the bioaccumulation study.

7.4.3 Sources of Uncertainty

There are several sources of uncertainty associated with the prediction of risk for both the benthic invertebrate and bottom fish community. Some uncertainties are common to both the benthic and bottom fish evaluations, and some are specific to each. The uncertainties associated with the ecological risk evaluations are presented below as uncertainties common to both benthic and bottom fish risk estimates, followed by separate discussions of uncertainties specific to each the benthic and bottom fish risk estimates. **Table 7-19** presents a summary of uncertainties and their potential impact upon the risk estimates.

7.4.4 Uncertainties Common to Benthic Invertebrate and Bottom Fish Risk Estimates

7.4.4.1 Sample Locations

Sediment chemical concentrations and toxicity test responses measured at discrete sampling locations were considered representative of contaminant conditions and biological effects over larger areas. This assumption could either over- or underestimate risks associated with a given area.

7.4.4.2 Exposure Assumptions

Contaminant exposure data were averaged for bioaccumulative contaminants that were detected in fish and clams from the background areas as well as the MSU. This is likely to result in added uncertainty of the exposure to receptors who may be exposed to concentrations greater or less than those represented by an average of samples. Undetected constituent concentrations were also factored into the exposure data for 2,3,7,8-TCDD equivalents in fish and clams and for PAHs in clams from the MSU by using the maximum sample quantitation limits corresponding to each of the undetected values. This will overestimate potential exposure because the undetected concentrations are really the highest possible estimates and are likely to be below the maximum sample quantitation limit.

7.4.5 Uncertainties Associated with Benthic Invertebrate Risk Estimates

7.4.5.1 Statistical Evaluations

The statistical analyses conducted as part of the risk characterization process have inherent uncertainty, such as making an error in statistical decisions based on chance alone (i.e., a Type I error which could overestimate the potential risk or a Type II error, which would underestimate the risk). Typical sampling designs also often do not meet all underlying statistical assumptions, which adversely affect the accuracy of outcomes, resulting in risk uncertainty.

As part of the uncertainty analysis, the statistical power of each bioassay was evaluated. Power exceeded 0.80 for the mortality comparisons, indicating that it was unlikely that a "hit" or impacted sample was undetected. The power was high, in large measure, because the differences between site and control were great (up to 24 times the mean control value). In the case of clam mortality, the power to statistically distinguish any test result from the mean control value of zero was exceptionally high. The power to detect differences from the mean control clam growth rate, however, was compromised by the variability in the growth data. In general, there was inadequate power to determine if rates were significantly different.

7.4.5.2 Background Areas

Evaluations of benthic impacts rely heavily on comparisons with background areas. Although every effort was made to match background area habitat characteristics (e.g., substrate type and water depth) with the MSU, small variations in such characteristics can equate to larger differences in receptor communities, which could subsequently be interpreted as being due to contaminant effects rather than natural variations, a result that may overestimate risk.

Conversely, risks could be underestimated if the sampled background areas are not representative of healthy communities. Sampling two background areas and selecting the most appropriate one for use based on similarity in substrate type, as was done for this risk assessment, contributed to a reduction in background area uncertainty, but nevertheless, risks may have been over- or underestimated due to background area selection.

7.4.5.3 Laboratory Bioassays

The amphipod, echinoderm embryo, and clam toxicity tests are laboratory assays, which do not necessarily reflect *in situ* conditions. Risks may be underestimated because exposure times are insufficient to represent long-term contaminant effects. Sediment collection procedures, as well as laboratory manipulations (e.g., aeration), may liberate previously non-bioavailable contaminants, subsequently resulting in higher or more frequent toxic responses than may be occurring under *in situ* conditions, which, in turn, could result in an overestimate of risk. The collection of *in situ* benthic community data at co-located stations, and interpretation of bioassay results in light of the sediment chemical data, helped to reduce the overall uncertainty associated with the laboratory results.

There is uncertainty regarding the ecological significance of echinoderm embryo responses with respect to *in situ* sediment contaminants. Bioassays conducted using larval stages may only serve as indicators of relative toxicity among tested samples, as these larvae normally reside in the water column rather than in close contact with sediment. In addition, the relative sensitivity of the mortality and developmental abnormality from toxic chemicals and natural chemical and physical factors have not been thoroughly evaluated. These factors may contribute to either an under- or overestimate of risk. Also, poor recovery of surviving larvae from test chamber sediment may result in an underestimate of the developmental abnormalities (PSEP 1995), and thus an underestimate of risk, or an overestimate of mortality, with an associated overestimate of risk. As stated above, the collection and interpretation of *in situ* benthic community data, as well as sediment chemical data, at stations with co-located bioassay results helped to reduce the overall uncertainty associated with the laboratory measures.

There is uncertainty regarding the predictiveness of the amphipod bioassay in determining potential toxicity from exposures to various levels of PAH contamination, based on the lack of correlation among mortality responses and sediment PAH concentrations. Further review of the amphipod data indicated that the mortality results for five stations appeared to substantially overestimate risks to these receptors from sediment. Comparisons of the sediment chemical data for each of the nine MSU stations with amphipod-specific AETs indicated that toxic responses would be predicted at four stations (EB80, EB85, EB87, and EB104), and would not be anticipated at the remaining five stations. However, toxic responses were observed at each of the nine stations, and three of the five highest observed mortalities occurred at stations at which toxic responses were not predicted by the amphipod-specific AETs. One reason for this lack of concurrence between sediment chemical concentrations and amphipod test response could be the species tested, as the amphipod AETs were derived based on toxicity tests using *Rhepoxynius abronius* rather than *Ampelisca abdita* (which was the test organism used in the MSU bioassays); however, this would not explain the overall lack of association between the test results and measured chemical concentrations. Because of the uncertainties regarding these test results, the amphipod bioassay data were not given consideration in the preponderance of evidence approach, which may have resulted in an underestimate of risks to benthic receptors. However, the use of other field and laboratory evidence of biological impacts helped reduce the overall uncertainty associated with the risk.

The failure of the Elliott Bay and Carr Inlet background sediments to meet performance criteria also introduces uncertainty into the assessment of the MSU bioassays. The site-related bioassay data were interpreted relative to control responses, which are inherently conservative and may not reflect bay-wide or Puget Sound-wide conditions. The comparisons to controls may therefore have overestimated risks to benthic receptors.

The results of the sampling efficiency analysis suggested that additional replication may have been necessary to detect true, statistically significant differences in echinoderm embryo response between three MSU stations (EB49, EB60, and EB77) and background (or, in this case, the substituted control response), which could have resulted in an underestimate of risk. However, the observed effective mortalities at these three stations were relatively low (10 to 13 percent), suggesting the test sediments were not toxic to echinoderm larvae and that associated impacts and risks based on these data were not underestimated.

7.4.5.4 Toxicity Data

Sediment contaminants of concern were identified based on comparisons with effects-based SMS SQS chemical criteria and AET screening values. The method by which the AET sediment screening values (and subsequently the SMS chemical criteria) were defined assumes that chemical concentrations can be used to predict adverse biological threshold responses. However, the accuracy of the prediction can potentially be altered by physical variables (e.g., grain size and TOC) or the presence of synergistic effects from multiple or unmeasured chemicals. Subsequently, risks could be under- or overestimated if the criteria used to define the contaminants of concern were not predictive of actual effects based on site-specific conditions. The results of the correlation analyses among sediment chemical and biological data suggest that the effects-based criteria were relatively predictive of acute toxicity to echinoderm embryos, but were not predictive of amphipod mortality responses (see discussion below).

Use of an indicator species in laboratory bioassays as surrogates for predicting impacts to benthic communities may not reflect the most sensitive members of a community, nor be indicative of a community-level response, which may underestimate risk.

The use of maximum detection limits as representative of background clam tissue concentrations for chemicals not detected in these tissue samples may have contributed to an underestimate of site-related risks, as the actual background concentrations of such chemicals were likely lower than the detection limits (meaning site-related concentrations could have been identified as more highly elevated relative to background).

7.4.6 Uncertainties Associated with Bottom Fish Risk Estimates

7.4.6.1 Exposure Assumptions

The bioavailability of contaminants represents a major source of uncertainty. Bioavailability (and bioaccumulation) of contaminants in sediment was assumed to be 100 percent. Complete bioavailability of contaminants is likely to overestimate potential cleanup levels since chemicals in the ambient environment are quite frequently bound as complexes reducing overall bioavailability and subsequent toxicity. Inorganic contaminants were assumed to be 100 percent bioavailable. Total inorganic concentrations were also compared to toxicity criteria derived in many cases based on contaminants which may or may not be similar to those measured as total concentrations in the MSU.

Contaminant exposure to the eggs of bottom fish was modeled from concentrations measured in adult fish using maternal transfer coefficients based on the literature as well as on professional judgment rather than on actual field measurements.

Contaminants other than those retained in tissues can cause deleterious effects in fish or their offspring. For example, risks to fish from exposure to PAHs are likely to be significant given that effects such as reduced immune system function, development of lesions or tumors, induction of mutations or impairment of cortisol stress response may occur at sediment concentrations several times to an order of magnitude lower than concentrations causing effects to benthic invertebrates (IT Corp 1997). However, body burdens of PAHs cannot be effectively measured because fish and other higher order vertebrates can break down PAHs in their bodies and excrete them as wastes. Therefore, bioaccumulation, as a measure of fish community health, underestimates risks to these receptors from some types of contaminants.

7.4.6.2 Toxicity Data

The toxicity assessment assumed a positive correlation between increasing contaminant concentration and increasing adverse effect to fish. This assumption establishes a necessary and critical relationship for assessing ecological toxicity, called the dose-response relationship. In other words, as the dose or contaminant concentration increases, adverse effects increase. However, species-specific factors such as uptake, disposition, and metabolism of contaminants, as well as interspecies differences in concentration and tissue distribution all play a role in determining the relative sensitivity of different receptors to contaminants. In summary, the differences exhibited within and/or between species within the MSU may or may not accurately reflect the true dose-response relationships.

In choosing toxicity benchmark values for 2,3,7,8-TCDD equivalents, the decision was made to select the highest NOAEL value. In some instances, this value represented a higher concentration than the lowest LOAEL value. Choice of the NOAEL over the LOAEL in these instances resulted in an under-estimation of risk to juvenile/adult fish following 2,3,7,8-TCDD equivalent exposure. For 2,3,7,8-TCDD equivalent, the lowest LOAEL value was 300 ng/kg-ww, which is approximately the same as the NOAEL value of 314 ng/kg-ww used in risk estimates. Use of the lowest LOAEL value in this instance would result in negligible change to the HQ.

Uncertainty was also introduced by using the highest available NOAEL value, as opposed to the lowest available NOAEL value. In all but one instance (evaluation of 2,3,7,8-TCDD equivalent risk to adult/juvenile fish) the NOAEL value used was the only NOAEL available. However, for 2,3,7,8-TCDD equivalent exposure to adult/juvenile fish, there was a NOAEL value of 21 ng/kg-ww available. Use of this lower NOAEL would have elevated risk estimates by more than an order of magnitude, but this would have likely been an overestimate of risk since the lowest reported LOAEL was 300 ng/kg-ww (a value similar to the NOAEL used in risk estimates).

A major uncertainty in using laboratory information to characterize risk to organisms in natural systems is extrapolating effects information among different exposure conditions. This is especially true for highly bioaccumulative chemicals such as 2,3,7,8-TCDD equivalents. Various routes of exposure were used, including waterborne, injection, and diet. For waterborne exposures, the duration of exposure varied from six hours to several weeks. Because 2,3,7,8-TCDD equivalents accumulate slowly, the exposure concentrations needed to elicit effects change greatly over this range of durations. Among those studies using exposure via water, bioavailability probably varied due to the effects of different amounts and types of solvent carriers and natural organic matter in the test systems. Buildup of organic matter would be of particular concern for static exposures, which also would have exhibited declining contaminant exposure concentrations with time. Finally, because of delays in response to a toxic dose, it is sometimes unclear to what magnitude and duration of exposure an organism is actually responding.

No information is currently available in the literature that measures the toxicity of mixtures of chemicals. It is possible that chemical-chemical interactions in mixtures can result in an overall lover toxicity to the receptor (i.e., an antagonistic effect); a toxicity equal to the sum of the toxicity of individual chemicals (i.e., an additive effect); or a toxicity larger than the sum of individual chemical toxicities (i.e., a synergistic effect). The risk assessment process assumes that the toxicity of chemicals is additive. If the true toxicity of the mixture is either antagonistic or synergistic, risk estimates would be overestimated or underestimated, respectively.

7.5 SUMMARY OF RISKS

Ecological risks were assessed through an evaluation of potential toxic effects to several receptors potentially exposed to sediment bound contaminants at the site, including fish, fish eggs, and the benthic community. Under current conditions no risks were identified for fish or fish eggs due to dioxins and furans in marine sediments at the PSR site. However, risks from exposure to contaminants (specifically PAHs) that fish are able to metabolize could not be addressed by measuring accumulation in tissues. Some potential risks were identified for benthic receptors. Animals exposed to sediment in a laboratory bioassay suggested that a wide range or effects could be occurring to benthic organisms at the site. An evaluation of the benthic community structure at the site suggested that lower-level effects than those predicted were occurring.

Three of nine stations were associated with potential moderate impacts to benthic receptors, one of the nine stations were associated with potential minimal to moderate impacts, and the remaining five stations were associated with potential low-level impacts. Seven of the nine stations associated with low to moderate impacts would be cleaned following remediation to CSLs. The remaining two stations with low potential impacts would be remediated if cleanup to SQS occurs. Additionally, following cleanup to CSLs, site-wide average concentrations of all COPCs in marine sediments fall below their respective CSLs, except four individual PAHs (naphthalene, acenapthene, fluoranthene, and pyrene). Residual sediment concentrations of the remaining four PAHs also fall below CSLs following remediation that attains concentrations at SQS levels.

SECTION 7 TABLES

Table 7-1—COPC Hazard Quotients and Hazard Indices Based on Comparisons with SQS/LAET Chemical Criteria

Chemical	Marine Sediments Unit Station SQS/LAET Chemical Hazard Quotients									Total Chemical SQS/LAET HI	Number of HQs > 1	Average Chemical SQS/LAET HI
	EB49	EB60	EB67	EB77	EB80	EB85	EB87	EB104	EB106			
LPAHs												
2-Methylnaphthalene			1.12	1.23	3.25	3.27	9.46	6.90		25.24	6	4.21
Naphthalene			1.90	1.70	5.23	4.07	13.59	11.07		37.56	6	6.26
Acenaphthene		1.91	4.23	3.98	12.10	9.44	22.70	24.83	1.95	81.14	8	10.14
Fluorene		1.35	2.76	2.33	6.94	6.47	18.60	17.55	1.54	57.54	8	7.19
Phenanthrene			1.69	1.41	4.49	4.23	11.09	9.64	1.12	33.66	7	4.81
Anthracene							4.17	1.89		6.06	2	3.03
Total LPAH			1.61	1.31	3.95	3.35	11.30	8.88		30.41	6	5.07
HPAHs												
Fluoranthene			2.45		2.18	2.02	6.19	5.57		18.42	5	3.68
Pyrene							1.16	1.28		2.45	2	1.22
Benzo(a)anthracene							1.95	1.12		3.07	2	1.54
Chrysene			1.28				2.53	1.55	1.11	6.47	4	1.62
Total Benzofluoranthene							1.70			1.70	1	1.70
Benzo(a)pyrene							1.59			1.59	1	1.59
Indeno(1,2,3-cd)pyrene	1.47		1.00				1.66		1.19	5.31	4	1.33
Dibenz(a,h)anthracene	1.36						1.51			2.87	2	1.44
Benzo(g,h,i)perylene	1.43		1.03				1.51		1.11	5.07	4	1.27
Total HPAH			1.46		1.32		3.46	2.89		9.13	4	2.28
Inorganics												
Mercury					1.76		1.09			2.85	2	1.42
Total Station SQS/LAET HI	4.26	3.25	20.52	11.96	41.23	32.87	115.27	93.15	8.02			
Number of HQs > 1	3	2	11	6	9	7	18	12	6			
Average Station SQS/LAET HI	1.42	1.63	1.87	1.99	4.58	4.70	6.40	7.76	1.34			

Table 7-2—COPC Hazard Quotients and Hazard Indices Based on Comparisons with CSL/2LAET Chemical Criteria

Chemical	Marine Sediments Unit Station CSL/2LAET Chemical Hazard Quotients									Total Chemical CSL/2LAET HI	Number of HQs > 1	Average Chemical CSL/2LAET HI
	EB49	EB60	EB67	EB77	EB80	EB85	EB87	EB104	EB106			
LPAHs												
2-Methylnaphthalene					1.93	1.94	5.62	4.10		13.59	4	3.40
Naphthalene			1.10		3.05	2.37	7.91	6.44		20.88	5	4.18
Acenaphthene			1.19	1.12	3.40	2.65	6.37	6.97		21.69	6	3.62
Fluorene					2.02	1.88	5.41	5.11		14.43	4	3.61
Phenanthrene							2.31	2.01		4.32	2	2.16
Anthracene										0.00	0	0.00
Total LPAH					1.87	1.59	5.36	4.21		13.04	4	3.26
HPAHs												
Fluoranthene										0.00	0	0.00
Pyrene										0.00	0	0.00
Benzo(a)anthracene										0.00	0	0.00
Chrysene										0.00	0	0.00
Total Benzofluoranthene										0.00	0	0.00
Benzo(a)pyrene										0.00	0	0.00
Indeno(1,2,3-cd)pyrene										0.00	0	0.00
Dibenz(a,h)anthracene										0.00	0	0.00
Benzo(g,h,i)perylene										0.00	0	0.00
Total HPAH										0.00	0	0.00
Inorganics												
Mercury					1.22					1.22	1	1.22
Total Station CSL/2LAET HI	0.00	0.00	2.29	1.12	13.49	10.44	32.99	28.84	0.00			
Number of HQs > 1	0	0	2	1	6	5	6	6	0			
Average Station CSL/2LAET HI	0.00	0.00	1.15	1.12	2.25	2.09	5.50	4.81	0.00			

Table 7-3—Sediment Concentration Background Exceedance Ratios for Nine Biological Sampling Stations in PSR Marine Sediments Unit

Chemical	Average Background Concentration	EB049	EB060	EB067	EB077	EB080	EB085	EB087	EB104	EB106	Total Chemical Background ER	Number of ERs >1	Average Chemical Background ER
PAHs (µg/kg-DW)													
Naphthalene	83.93	3.74	11.27	38.01	30.15	135.84	86.51	352.70	287.16	6.26	951.62	9	105.74
Acenaphthylene	23.34	4.37	4.09	10.28	4.93	16.28	6.21	17.61	10.20	4.63	78.60	9	8.73
Acenaphthene	76.44	2.00	4.79	15.04	12.49	55.73	35.58	104.53	114.34	5.30	349.80	9	38.87
Fluorene	79.82	2.66	4.66	13.53	10.07	43.97	33.58	117.89	111.25	5.76	343.37	9	38.15
Phenanthrene	750.40	1.33	1.44	3.82	2.81	13.15	10.14	32.52	28.25	1.95	95.42	9	10.60
Anthracene	252.30	2.32	2.76	6.38	3.03	10.82	7.61	80.06	36.19	2.96	152.14	9	16.90
Total LPAH	*1,249.44*	*1.89*	*2.85*	*8.12*	*5.83*	*25.73*	*17.88*	*73.64*	*57.86*	*2.97*	*196.75*	*9*	*21.86*
Fluoranthene	805.00	2.84	1.98	8.29	2.58	9.55	7.23	27.08	24.35	2.37	86.27	9	9.59
Pyrene	1,317.60	3.48	1.51	5.56	2.21	8.58	4.80	19.43	21.40	1.73	68.69	9	7.63
Benzo(a)anthracene	502.58	2.79	1.34	3.14	0.98	2.71	1.79	9.41	5.37	2.01	29.54	8	3.69
Chrysene	592.60	3.59	2.18	4.03	1.43	3.34	1.79	10.34	6.31	2.68	35.70	9	3.97
Benzo(b)fluoranthene	503.00	5.65	2.74	4.57	2.01	4.47	2.78	12.88	6.24	3.90	45.25	9	5.03
Benzo(k)fluoranthene	212.72	5.88	2.61	4.33	1.69	4.15	2.05	9.92	4.35	3.24	38.22	9	4.25
Total Benzofluoranthene	715.72	5.71	2.70	4.50	1.91	4.38	2.57	12.00	5.68	3.70	43.16	9	4.80
Benzo(a)pyrene	467.28	4.28	1.84	2.80	1.23	2.74	1.52	7.40	3.32	2.57	27.71	9	3.08
Indeno(1,2,3-cd)pyrene	231.12	4.76	1.74	2.50	1.11	2.35	1.27	5.37	2.22	2.27	23.57	9	2.62
Dibenz(a,h)anthracene	58.58	6.15	2.01	3.35	1.27	2.87	1.45	6.79	2.97	2.65	29.50	9	3.28
Benzo(g,h,i)perylene	231.06	4.21	1.51	2.35	0.97	2.25	1.22	4.46	2.04	1.93	20.92	8	2.61
Total HPAH	*4,921.54*	*3.85*	*1.87*	*4.84*	*1.79*	*5.68*	*3.52*	*14.83*	*12.40*	*2.39*	*51.16*	*9*	*5.68*
Total B(a)P equivalent	*652.25*	*4.46*	*1.89*	*3.01*	*1.28*	*2.87*	*1.62*	*7.87*	*3.64*	*2.63*	*29.26*	*9*	*3.25*
Dioxins (ng/kg-DW)													
2,3,7,8-TCDD (equivalent)	1.05	17.59	13.15	4.95	4.42	1.85	7.12	21.72	8.22	12.50	91.52	9	10.17
Total Station Background ER		93.55	70.92	153.41	94.19	359.30	238.22	948.45	753.75	76.38			
Number of ERs >1		21	21	21	19	21	21	21	21	21			
Average Station Background ER		4.45	3.38	7.31	4.49	17.11	11.34	45.16	35.89	3.64			

Table 7-4—Summary of Acute Biological Effects Test Results

Station	Amphipod (*Ampelisca abdita*) 10-day Acute Bioassay				Echinoderm (*Dendraster excentricus*) 72-hour Acute Bioassay		
	Average Mortality (%)	t-test Probability Level[b]	ANOVA with Dunnett's P-level[b]	SMS Exceedance Level[b]	Average Effective Mortality (%)	Mann-Whitney U Probability Level[b]	SMS Exceedance Level[b]
PSR Marine Sediments Unit							
EB49	28	<0.028	<0.080	SQS	10.0	<0.016	--
EB60	61	<0.001	<0.001	CSL	10.8	<0.003	--
EB67	46	<0.001	<0.001	CSL	28.0	<0.001	SQS
EB77	51	<0.003	<0.001	CSL	13.1	<0.003	--
EB80	43	<0.004	<0.001	CSL	21.1	<0.001	SQS
EB85	51	<0.002	<0.001	CSL	31.7	<0.001	CSL
EB87	72	<0.001	<0.001	CSL	41.3	<0.001	CSL
EB104	43	<0.002	<0.001	CSL	49.0	<0.001	CSL
EB106	37	<0.014	<0.011	SQS	16.7	<0.001	SQS
Background							
BK01 (Magnolia)	68[a]	NA	NA	NA	75.0[a]	NA	NA
BK04 (Alki)	42[a]	NA	NA	NA	64.4[a]	NA	NA
Carr Inlet	36[a]	NA	NA	NA	37.0[a]	NA	NA
Control							
Control	9	NA	NA	NA	0.0	NA	NA

NA = Not applicable.
-- = Result does not exceed SMS biological effects criteria.
[a] This level of response at a reference station fails a performance criterion for acceptance as reference.
[b] Significance tests and SMS outcome were based on comparison to control results.
SQS = Sediment Quality Standards
CSL = Cleanup Screening Level

Table 7-5—Summary of Clam Bioassay Results

Station	Average Mortality (%)	Exceeds Probable Effects Criterion?	Average Growth Rate (mg/ind/day)	Exceeds Probable Effects Criterion?
PSR Marine Sediments Unit				
EB49	2	No	-0.005	No
EB60	0	No	-0.001	No
EB67	0	No	-0.001	No
EB77	0	No	-0.002	No
EB80	0	No	0.000	No
EB85	0	No	-0.001	No
EB87	2	No	-0.001	No
EB104	2	No	0.000	No
EB106	2	No	-0.002	No
Background				
BK01 (Magnolia)	0	NA	0.001	NA
BK04 (Alki)	0	NA	0.000	NA
Control				
Control	2	NA	-0.005	NA

NA = Not applicable

Table 7-6—Abundance and Richness of Benthic Infaunal Organisms

	Abundance (# individuals/0.1m^2)							Richness (# taxa/0.1m^2)						
Station	Rep A	Rep B	Rep C	Rep D	Rep E	Average	Total[a]	Rep A	Rep B	Rep C	Rep D	Rep E	Average	Total[a]
Marine Sediments Unit														
EB49	1020	805	1041	868	857	918**	4591	104	87	84	82	85	88	152
EB60	1534	1547	1283	1756	1333	1491**	7453	90	84	71	89	90	85	177
EB67	1099	864	771	1188	1554	1095**	5476	83	81	67	78	100	82	174
EB77	1244	1399	847	1479	1349	1264**	6318	83	82	84	91	103	89	157
EB80	546	1199	1497	1409	1311	1192**	5962	72	72	77	78	84	77*	155
EB85	1381	1848	977	1585	1547	1468**	7338	71	100	68	93	97	86	152
EB87	1175	1065	1320	1185	1264	1202**	6009	112	106	109	109	121	111**	205
EB104	1813	1212	1434	1272	1055	1357**	6786	119	119	113	103	101	111**	203
EB106	715	767	797	747	621	729	3647	80	92	86	81	82	84	165
Background Area														
	707	845	689	638	751	726	3630	94	96	88	73	90	88	161

Rep: Replicate

[a]Total abundance and richness represent value/0.5m^2

*Significantly less than Background Station BK04

**Significantly higher than Background Station BK04

Table 7-7—Average Total Abundance and Relative Total Abundance of Benthic Major Taxonomic Groups

Station	Average Total Abundance (# individuals/0.1m²)				Relative Total Abundance (%)			
	Crustaceans	Molluscs	Polychaetes	Misc. Taxa	Crustaceans	Molluscs	Polychaetes	Misc. Taxa
Marine Sediments Unit								
EB49	124	511**	257	27	13	56	28	3
EB60	281**	883**	281	46	19	59	19	3
EB67	222**	612**	223	39	20	56	20	4
EB77	353**	564**	333**	13*	28	45	26	1
EB80	195**	763**	216	18*	16	64	18	2
EB85	305**	901**	244	17*	21	61	17	1
EB87	250**	281	654**	17*	21	23	54	1
EB104	292**	599**	437**	29*	21	44	32	2
EB106	114	304	279	33	16	42	38	5
Background Area								
BK04 (Alki)	131	272	256	67	18	37	35	9

*Significantly lower than Background Station BK04
**Significantly higher than Background Station BK04

Table 7-8—Benthic Major Taxonomic Group Richness

Station	Average Richness (#taxa/0.1m²)				Total Richness (# taxa/0.5m²)			
	Crustaceans	Molluscs	Polychaetes	Misc. Taxa	Crustaceans	Molluscs	Polychaetes	Misc. Taxa
Marine Sediments Unit								
EB49	10*	20	51	8**	19	29	90	13
EB60	10*	21	48	6	19	34	92	10
EB67	14	18*	44	6	32	25	84	8
EB77	12	20	53**	4*	28	30	92	7
EB80	13	17*	42	5	26	27	92	10
EB85	17	19*	46	5*	33	28	84	7
EB87	20**	19*	67**	6	40	33	119	13
EB104	22**	21	63**	5	50	34	110	9
EB106	14	18*	45	7	29	34	89	13
Background Area								
BK04 (Alki)	14	22	46	6	30	34	86	11

*Significantly less than Background Station BK04
**Significantly higher than Background Station BK04

Table 7-9—Top 10 Numerically Dominant Taxa Based on Total Pooled Abundance (# individuals/0.5 m^2) and Swartz's Dominance Index

		Relative Abundance (%)									
	Major	Marine Sediments Unit Stations									Background Area
Species	Taxa Group	EB49	EB60	EB67	EB77	EB80	EB85	EB87	EB104	EB106	BK04 (Alki)
Balanomorpha	Crustacea		2								
Eudorella pacifica	Crustacea					1					
Euphilomedes carcharodonta	Crustacea	11	11	9	10	6	8	13	10	11	7
Euphilomedes producta	Crustacea		5	8	14	8	9	2	6		9
Rutiderma lomae	Crustacea				2		2				
Solidobalanus hesperius	Crustacea							1			
Astyris gausapata	Mollusca									2	3
Axinopsida serricata	Mollusca	22	36	32	17	34	26	9	22	22	11
Macoma carlottensis	Mollusca	5	9	6	6	8	8		7	4	4
Macoma yoldiformis	Mollusca	6									
Macoma sp. Juv.	Mollusca		3	11	15	17	21		5		7
Parvilucina tenuisculpta	Mollusca	15	6	1	2	1	2	10	6	8	4
Psephidia lordi	Mollusca	2									
Lumbrineris californiensis	Polychaeta							4			
Magelona longicornis	Polychaeta	2								2	
Mediomastus sp. Indet.	Polychaeta							1			
Myriochele heeri	Polychaeta		2		3	1	1				
Paraprionospio pinnata	Polychaeta							2		2	
Pectinaria californiensis	Polychaeta		4	5	5	4	4		2		10
Pholoides asperus	Polychaeta								3		
Prionospio jubata	Polychaeta	2	2	1	4	2	2	10	6	3	3
Proclea graffi	Polychaeta			2							
Scoletoma luti	Polychaeta	2								3	
Spiochaetopterus costarum	Polychaeta	5						14	3	11	
Ophiurida sp. Indet.	Misc. Taxa			2							4
Relative % Abundance of Top 10 Taxa		**72**	**79**	**78**	**76**	**82**	**82**	**65**	**70**	**69**	**61**
Swartz's Dominance Index		**12.38**	**7.20**	**7.88**	**9.21**	**5.55**	**5.84**	**18.16**	**14.53**	**14.57**	**19.29**

Table 7-10—Relative Abundance and Richness of Pollution-Tolerant and -Sensitive Taxa

	Marine Sediments Unit Stations									Background Area
	EB49	EB60	EB67	EB77	EB80	EB85	EB87	EB104	EB106	BK04 (Alki)
Relative Abundance[a] (%)										
Pollution-Sensitive Taxa	2	7	8	6	6	5	4	5	4	20
Pollution-Tolerant Taxa	46	56	55	47	66	62	35	48	40	32
Organic Enrichment-Tolerant Taxa	27	23	19	26	15	19	26	22	21	19
Relative Richness[b] (%)										
Pollution-Sensitive Taxa	11	6	10	11	14	13	12	14	12	12
Pollution-Tolerant Taxa	23	20	17	20	21	19	21	20	23	16
Organic Enrichment-Tolerant Taxa	5	4	3	4	5	5	4	3	4	3

[a]Represents percentage of total station abundance
[b]Represents percentage of total station richness

Table 7-11—Probability of Significant Differences Between Station Pairs Based on t-Tests

Station	Comparisons Between Marine Sediments Unit Stations and Background Station BK04 (Alki)[a]									
	Abundance					Richness				
	Crustacea	Mollusca	Polychaeta	Misc. Taxa	Total	Crustacea	Mollusca	Polychaeta	Misc. Taxa	Total
EB49	<0.319	**<0.001**	<0.439	<0.113	**<0.005**	**<0.016**	<0.160	<0.142	**<0.057**	<0.487
EB60	**<0.000**	**<0.000**	<0.356	<0.414	**<0.000**	**<0.024**	<0.329	<0.382	<0.393	<0.288
EB67	**<0.034**	**<0.001**	<0.117	<0.294	**<0.016**	<0.447	**<0.035**	<0.327	<0.500	<0.185
EB77	**<0.002**	**<0.001**	**<0.005**	**<0.019**	**<0.002**	<0.163	<0.193	**<0.042**	**<0.020**	<0.473
EB80	**<0.019**	**<0.011**	<0.084	**<0.040**	**<0.037**	<0.204	**<0.014**	<0.111	<0.265	**<0.023**
EB85	**<0.000**	**<0.000**	<0.301	**<0.041**	**<0.001**	<0.177	**<0.063**	<0.443	**<0.056**	<0.385
EB87	**<0.002**	<0.346	**<0.000**	**<0.033**	**<0.000**	**<0.024**	**<0.051**	**<0.001**	<0.291	**<0.001**
EB104	**<0.000**	**<0.009**	**<0.002**	<0.148	**<0.001**	**<0.022**	<0.264	**<0.001**	<0.114	**<0.002**
EB106	<0.115	<0.262	<0.263	<0.169	<0.467	<0.442	**<0.030**	<0.323	<0.211	<0.209

[a]Probabilities adjusted to reflect one-sided test results (appended results present two-sided probabilities)
Shaded values statistically significantly (P<0.10) different from Background Station BK04

Table 7-12—Percent Similarities Among Benthic Communities From Cluster Analysis Based on Total Taxa Abundance (n>8)[a]

Clusters Linked (Stations)		Percent Similarity
EB77	EB85	84
EB67	EB77	79
EB49	EB106	77
EB67	EB80	76
EB60	EB67	75
EB87	EB104	74
EB60	BK04 (Alki)	72
EB49	EB87	65
EB49	EB60	61
EB49	BK01 (Magnolia)	35

[a]Data were log(x+1)-transformed prior to analysis

Table 7-13—Clam Tissue COPC Exceedance Ratios Based on Comparisons with Elliott Bay Background Concentrations

Chemical	Marine Sediments Unit Station Background Chemical Exceedance Ratios									Total Chemical Bkgd. ER	Number of Bkgd. ERs > 1	Average Chemical Bkgd. ER
	EB49	EB60	EB67	EB77	EB80	EB85	EB87	EB104	EB106			
LPAHs												
Fluorene[a]								1.25		1.25	1	1.25
Phenanthrene	1.76	1.81	1.64	1.43	1.26	1.58	3.16	9.77	1.37	23.78	9	2.64
Anthracene	5.19	4.62	8.94	4.26	3.32	3.86	19.64	289.14	4.93	343.90	9	38.21
Total LPAH	4.05	3.62	5.89	3.14	2.58	3.38	12.66	131.42	3.33	170.07	9	18.90
HPAHs												
Fluoranthene	6.87	6.30	37.72	2.23	1.52	1.63	13.91	37.98	6.33	114.49	9	12.72
Pyrene	17.54	7.24	28.37	4.75	5.88	10.91	27.35	40.50	5.76	148.30	9	16.48
Benzo(a)anthracene[a]		2.25	5.73				2.94	4.92	1.60	17.44	5	3.49
Chrysene	3.45	8.94	19.44	4.15	3.25	3.23	10.78	20.44	6.10	79.78	9	8.86
Total Benzofluoranthene	11.65	12.94	22.02	11.04	7.26	9.90	21.41	16.64	11.93	124.79	9	13.87
Benzo(a)pyrene	7.91	8.87	14.41	7.64	5.29	6.71	14.28	11.53	8.34	84.98	9	9.44
Indeno(1,2,3-cd)pyrene	3.46	4.18	6.64	4.24	2.89	2.91	5.81	4.66	3.32	38.11	9	4.23
Benzo(g,h,i)perylene	3.32	4.12	5.77	3.65	2.90	2.87	5.71	4.58	3.29	36.21	9	4.02
Total HPAH	10.53	9.65	26.68	6.64	5.29	7.37	19.72	27.87	8.29	122.04	9	13.56
Dioxins/Furans												
2,3,7,8-TCDD Equivalent	4.08	10.26	2.91	5.48	3.09	5.35	5.25	3.58	6.74	46.74	9	5.19
Total Station Bkgd. ER	79.81	84.80	186.16	58.65	44.53	59.70	162.62	604.28	71.33			
Number of Bkgd. ERs > 1	12	13	13	12	12	12	13	14	13			
Average Station Bkgd. ER	6.65	6.52	14.32	4.89	3.71	4.98	12.51	43.16	5.49			

[a]Not detected in background tissue samples; background concentration based on maximum detection limit

Table 7-14—Summary of Risk Results for Adult/Juvenile English Sole

Transect ID	Risk to Adult/Juvenile Fish	
	2,3,7,8-TCDD equivalent HQ	HQ
FT2-NORTH-ES	0.0012	< 1
FT2-WEST-ES	0.004	< 1

Note: Hazard quotients (HQs) are based on 2,3,7,8-TCDD equivalent whole body fish tissue concentration (wet weight) divided by the wet weight 2,3,7,8-TCDD equivalent fish effect level.

Table 7-15—Summary of Risk Results for the Eggs/Fry of English Sole

Transect ID	Risk to Eggs/Fry	
	2,3,7,8-TCDD equivalent HQ	HQ
FT2-NORTH-ES	0.0009	< 1
FT2-WEST-ES	0.02	< 1

Note: Hazard quotients (HQs) are based on 2,3,7,8-TCDD equivalent egg tissue concentration (wet weight) divided by the wet weight 2,3,7,8-TCDD equivalent egg effect level.

Table 7-16—Preponderance of Evidence Matrix for Benthic Risk Characterization

Station	Bioassays		Benthos											Chemistry		
	Amphipod (*A. abdita*)	Echinoderm (*D. excentricus*)	Average Abundance[a] (# individuals/0.1m²)					Average Richness[a] (# taxa/0.1m²)						Sediment		Clam Tissue
	% Mort	% Eff Mort	Crust	Moll	Poly	Misc	Total	Crust	Moll	Poly	Misc	Total	SDI	Avg. Station SQS/LAET HI	Avg. Station CSL/2LAET HI	Avg. Station Bkgd. ER
Marine Sediments Unit																
EB49	**28**	10.0	124	*511*	257	27	*918*	**10**	20	51	*8*	88	12.4	1.42	0.00	6.65
EB60	**61**	10.8	*281*	*883*	281	46	*1491*	**10**	21	48	6	85	7.2	1.63	0.00	6.52
EB67	**46**	**28.0**	*222*	*612*	223	39	*1095*	14	**18**	44	6	82	7.9	1.87	1.15	14.32
EB77	**51**	13.1	*353*	*564*	*333*	**13**	*1264*	12	20	*53*	**4**	89	9.2	1.99	1.12	4.89
EB80	**43**	**21.1**	*195*	*763*	216	**18**	*1192*	13	**17**	42	5	**77**	5.6	4.58	2.25	3.71
EB85	**51**	**31.7**	*305*	*901*	244	**17**	*1468*	17	**19**	46	**5**	86	5.8	4.70	2.09	4.98
EB87	**72**	**41.3**	*250*	281	*654*	**17**	*1202*	*20*	**19**	*67*	6	*112*	18.2	6.40	5.50	12.51
EB104	**43**	**49.0**	*292*	*599*	*437*	29	*1357*	*22*	21	*63*	5	*111*	14.5	7.76	4.81	43.16
EB106	**37**	**16.7**	114	304	279	33	729	14	**18**	45	7	*84*	14.6	1.34	0.00	5.49
Background Areas																
BK01 (Magn.)	68	75.0	40	145	369	251	805	18	25	75	14	132	43.1	0.00	0.00	NA
BK04 (Alki)	42	64.4	131	272	256	67	726	14	22	46	6	88	19.3	2.37[a]	0.00	NA

[a]Significance based on t-test result only.

Bold: For bioassay results, indicates exceedance of the SQS biological criterion; for benthic results, indicates result significantly lower than background station

Italicized: Indicates result significantly higher than background.

Shaded: Indicates exceedance of CSL biological criterion.

NA: Not applicable

Mort: Mortality; Eff Mort: Effective Mortality (Mortality + Abnormality)

Crust: Crustaceans

Moll: Molluscs

Poly: Polychaetes

Misc: Miscellaneous taxa

SDI: Swartz's Dominance Index

SQS: Sediment Quality Standard

CSL: Cleanup Screening Level

LAET: Lowest apparent effects threshold

2LAET: Second-lowest apparent effects threshold

HI: Hazard Index; based on sum of individual chemical hazard quotients > 1.0

ER: Exceedance ratio based on comparison to average background concentration

Table 7-17—Qualitative Matrix for Evaluating Risks to Benthic Receptors Based on Preponderance of Evidence Approach

Station	Relative Degree of Current Sediment Contamination	Relative Degree of Current Benthic Community Impacts													Relative Degree of COPC Bioaccumulation In Clam Tissues	Overall Benthic Impact Rating
		Acute Toxicity		Chronic Toxicity												
				Impacts to Benthic Abundance					Impacts to Benthic Richness							
		Amph[a]	Echino	Crust	Moll	Poly	Misc	Spp[b]	Crust	Moll	Poly	Misc	Total	SDI		
EB49	Low	Mod						Min	Min						Mod	Min
EB60	Low	Severe						Min	Min						Mod	Min
EB67	Mod	Severe	Mod					Min		Mod					High	Min
EB77	Mod	Severe				Min	Mod	Min				Min			Mod	Min
EB80	Mod	Severe	Mod				Mod	Min		Mod			Min		Mod	Min-Mod
EB85	Mod	Severe	Severe				Mod	Min		Min		Min		Mod	Mod	Mod
EB87	High	Severe	Severe			Mod	Mod	Min		Mod				Mod	High	Mod
EB104	High	Severe	Severe			Mod		Min							High	Mod
EB106	Low	Mod	Mod					Min		Mod					Mod	Min

[a]Results not considered in preponderance of evidence approach based on lack of association with sediment chemical concentrations of COPCs.

[b]Species-level comparison based on presence of pollution-tolerant and/or sensitive taxa.

Non: Non-impacted; Min: Minimally-impacted; Mod: Moderately-impacted

<u>Sediment Chemical Contamination</u>

Low = No CSL exceedances

Mod = CSL HQs between 1 and 5

High = CSL HQs > 5

<u>Acute Toxicity</u>

Mod = Exceeds SQS biological criterion

Severe = Exceeds CSL biological criterion

<u>Chronic Toxicity</u>

Min = Major Taxa Group: Significantly depressed relative to background based on t-test result only (Note: Polychaete abundance based on significant enhancement); Spp.-Level: Abundance of pollution-tolerant taxa elevated relative to background

Mod = Major Taxa Group: Significantly depressed relative to background based on both t-test and ANOVA results (see above Note re: polychaete enhancements); Spp.-Level: Abundance of pollution-tolerant taxa elevated relative to background and pollution-sensitive taxa depressed relative to background

Severe = Major Taxa Group: Greater than 50 percent reduction relative to background and statistically significantly lower than background; Spp.-Level: Dominance by pollution-tolerant taxa and absence of pollution-sensitive taxa

<u>Clam Tissue COPC Bioaccumulation</u>

Low = Background ER between 1 and 2

Mod = Background ER between 2 and 10

High = Background ER > 10

Table 7-18—Summary of Residual Ecological Risks

Receptor	Current Conditions	CSL-Based Cleanup	SQS-Based Cleanup	Cleanup of Entire Site
Station-by-Station HQ/ER				
Benthic Invertebrates	9/9	2/9	0/9	0/9
Clam Bioaccumulation	9/9	2/9	0/9	0/9
Bioaccumulative Contaminant				
Clam HQs[a]				
2,3,7,8-TCDD equiv.	96	11.0	5.2	4
Fish HQs[b]				
2,3,7,8-TCDD equiv.	< 1	NI	NI	NI
Fish Egg HQs[b]				
2,3,7,8-TCDD equiv.	<1	NI	NI	NI

Note: Current conditions represent the risks within the MSU prior to any cleanup activities. Benthic invertebrates were evaluated on a station-by-station basis (i.e., number of stations posing a risk out of the total number) and represent potential effects from all contaminants detected at that station. The bioaccumulative contaminant evaluation is based site-wide average hazard quotients (HQs) for 2,3,7,8-TCDD equivalents as the only site-related bioaccumulative contaminant of concern with available effects data.
NI - Cleanup not indicated based on risk evaluation.
[a]HQ based on comparison to average background using clam data extrapolated from sediment.
[b]HQ based on comparison to a no-effect level.

Table 7-19—Summary of Uncertainties and Their Potential Impacts on Actual Risks Relative to Risk Estimates

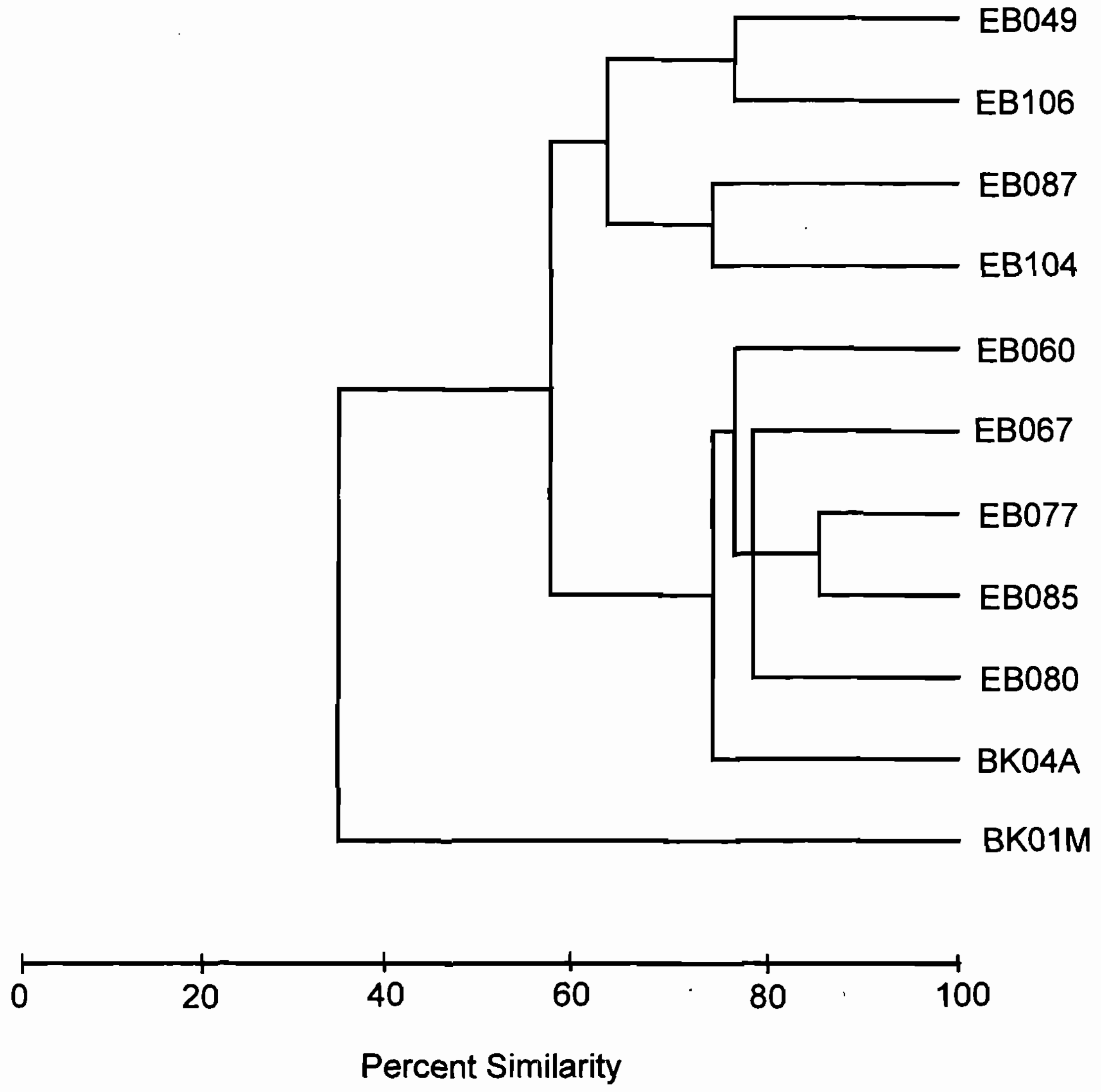
Assumption	Alternate Possibility	Effect on Actual Risks
Benthic Invertebrate and Bottom Fish Evaluation Uncertainties		
The areas sampled adequately characterized the nature and extent of contamination at the site.	The areas sampled may have either under or overpredicted site-related contamination	<
Clam and fish exposure to site-related chemicals is accurately predicted by using average tissue concentrations.	Clam and fish exposure to site-related chemicals is either over- or under-predicted for the majority of these receptors by use of the average tissue concentration.	<
Benthic Invertebrate Evaluation Uncertainties		
Statistical evaluations used accurately characterized the benthic community	Statistical evaluations either over- or underpredicted true differences between the site and reference area benthic communities.	<
Background area chosen is representative of a healthy community with habitat characteristics similar to those of the site.	Background area habitat may have subtle differences in substrate composition, making it less representative of site, or background area may not be representative of a healthy community.	<
The amphipod, echinoderm embryo, and clam toxicity laboratory assays accurately reflected *in situ* conditions.	• Laboratory exposure times are insufficient to reflect long-term exposure. • Laboratory preparation procedures may liberate previously non-bioavailable contaminants.	↑ ↓
Site-related bioassay data were interpreted relative to control responses (instead of to reference area responses).	A reference area responses met performance criteria and were used in site comparisons.	↓
Sufficient sampling was conducted to detect true statistical differences in echinoderm embryo response between marine sediments unit stations and control areas.	Insufficient sampling was conducted to detect true statistical differences in echinoderm embryo response between Marine Sediments Unit stations and control areas.	↑

Table 7-19—Summary of Uncertaintes and Their Potential Impacts on Actual Risks Relative to Risk Estimates

Assumption	Alternate Possibility	Effect on Actual Risks
Indicator species used in bioassays adequately predicted impacts to sensitive members of the benthic community, and community-level responses as a whole.	• Sensitive species are impacted more severely than indicator species. • Indicator species did not adequately predict community-level responses.	↑ <
Use of maximum detection limit accurately represents the actual concentration of an undetected chemical in background samples.	Actual background concentrations of undetected chemicals were lower than the maximum detection limit.	↓
Bottom Fish Evaluation Uncertainties		
Bioavailability of chemicals in sediment was 100%	Bioavailability of chemicals in sediment is less than 100%	↓
Chemical concentrations in eggs were modeled based on literature values derived for a different species of fish.	Literature values for site-specific fish were available and were used to model chemical concentrations in eggs.	<
Maximum detection limits accurately estimated the true concentration of undetected chemicals in fish/clam tissues collected at the site.	Actual tissue concentrations of undetected chemicals were lower than the maximum detection limit.	↓
The effects levels used, although based on studies of other species of fish and laboratory (as opposed to site) exposure conditions, adequately predicted the effects levels for fish at the site.	Site conditions vary from those at other sites and in the laboratory.	<
Risk posed by a mixture of chemicals is additive for each chemical in the mixture.	Risk posed by a mixture of chemicals is either less, due to antagonistic effects between chemicals in the mixture, or higher, due to synergistic effects between chemicals in the mixture.	<

< Risk may increase or decrease, if alternate case replaced assumption.
↑ Risk would increase if alternate case replaced assumption.
↓ Risk would decrease if alternate case replaced assumption.
N/A Not applicable.

SECTION 7 FIGURES



Dendrogram Resulting from Bray-Curtis Classification Analysis Using Total Taxa Abundance [n > 8; log (X + 1) - Transformed]

WESTON MANAGERS DESIGNERS/CONSULTANTS

Figure **7-1**

SECTION 8

REFERENCES

Adkins, L. 1997. Cartographer. Washington Department of Fish and Wildlife. Olympia, Washington. Personal communication/data report supplied to R. Sturim, Roy F. Weston, Inc., Seattle, WA. 21 May.

Bargman, G. 1991. Resource Manager, Washington State Department of Fisheries, Marine Fish and Shellfish Division, Seattle, WA. Personal communication with R. Sturim, Roy F. Weston, Inc. 10 July.

Bend, J.R., R.J. Pohl, N.P. Davidson, and J.R. Fouts. 1974. Responses of Hepatic and Renal Microsomal Mixed-Function Oxidases in the Littel Skate (*Raja erinacea*) to Pretreatment with 3-Methylcholanthrene or TCDD (2,3,7,8-Tetrachlorodibenzo-p-dioxin). *In* EPA (1993) Interim Report on 2,3,7,8-TCDD. *Bull. Mt. Desert Biol. Lab. 14:7-12.*

Branson, D.R., I.T. Takahashi, W.M. Parker, and G.E. Blau. 1985. Bioconcentration of 2,3,7,8-Tetrachlorodibenzo-p-dioxin in Rainbow Trout. *In* EPA (1993) Interim Report on 2,3,7,8-TCDD. *Environ. Toxicol. Chem. 4:779-788.*

Cain, Teresa. 1997. Point Whitney Shellfish Laboratory, Washington State Department of Fish and Wildlife. Personal communication with Nancy A. Musgrove, Roy F. Weston, Inc.

Calambokidas, J. 1991. Marine Mammal Specialist, Cascadia Research Collective, Olympia, WA. Personal communication with R. Sturim, Roy F. Weston, Inc. 29, January.

Cook, P.M. 1995. Personal Communication with Russ McMillan, Washington State Department of Ecology, Sediment Management Unit, Olympia, Washington. *In* Draft Memo to Charles Pitz, Cascade Pole Files, Dioxin Ecological Risk for Cascade Pole Sediments, dated March 17, 1995.

Cook, P.M., D.W. Kuehl, M.K. Walker, and R.E. Peterson. 1991. Bioaccumulation and Toxicity of TCDD and Related Compounds in Aquatic Ecosystems. *In* EPA (1993a) Interim Report on 2,3,7,8-TCDD. Banbury Report 35: Biological Basis for Risk Assessment of Dioxins and Related Compounds, Cold Spring Harbor Laboratory Press, Plainview, NY, pp. 146-167.

Dauer, D.M., W.W. Robinson, C.P. Seymour, and A.T. Leggett. 1979. Effects of Non-point Pollution on Benthic Invertebrates in the Lunnhaven River System. Virginia Water Resources Center. Bulletin 117.

Dexter, R., D. Anderson, E. Quinlan, L. Goldstein, R. Strickland, S. Pavlou, J. Clayton, R. Kocan, and M. Landolt. 1981. "A Summary of Knowledge of Puget Sound Related to Chemical Contaminants." NOAA Technical Memorandum OMPA-13, Boulder, CO, December, 1981.

Ecology (Washington State Deparment of Ecology). 1996. SMS Technical Information Memorandum: Quality Assurance Guidelines for the Sediment Larval Bioassay. Prepared by T. Michelsen, Washington Department of Ecology, Bellevue, WA, 25 July 1996. Sediment Management Annual Review Meeting Minutes, May 1996, SAIC, Bothel, WA.

Elliott, J.M. 1977. Some Methods for Statistical Analysis of Samples of Benthic Invertebrates. Freshwater Biological Association. Scientific Publication No. 25.

EPA (U.S. Environmental Protection Agency). 1997. IRIS Online Database.

EPA. 1996a. Proposed Guidelines for Ecological Risk Assessment. Risk Assessment Forum, U.S. EPA, Washington, D.C. EPA/630/R-95/002B. August.

EPA. 1996b. Process for Designing and Conducting Ecological Risk Assessments. U.S. EPA, Environmental Response Team, Edison, N.J. Internal Review Draft. 3 June.

EPA. 1996c. Risk Based Concentration Table. EPA, Region III Office of Technical and Program Support Branch. 9 August.

EPA. 1995a. Health Effects Assessment Summary Tables (HEAST) Online Database.

EPA. 1995b. Risk Characterization Guidance Memoranda. Office of the Administrator, Washington, D.C. March.

EPA. 1995c. Great Lakes Water Quality Initiative.

EPA. 1994. Region 10 Supplemental Guidance for Ecological Risk Assessments. Prepared by ICF Kaiser Engineers, Inc., Seattle, WA. Contract Number 68D10135.

EPA. 1993a. Interim Report on Data and Methods for Assessment of 2,3,7,8-Tetrachlorodibenzo-p-dioxin Risks to Aquatic Life and Associated Wildlife. U.S. EPA Office of Research and Development, Washington, D.C. EPA/600/R-93/055.

EPA. 1993b. Proceedings of the U.S. Environmental Protection Agency's National Technical Workshop "PCBs in Fish Tissue." U.S. EPA Office of Water, Washington, D.C. May 10-11. EPA/823-R-93-003.

EPA. 1992a. Framework for Ecological Risk Assessment. Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. EPA/630/R-92/001. February.

EPA. 1992b. Guidance on Risk Characterization for Risk Managers and Risk Assessors. Office of the Administrator, Washington, D.C. Memorandum from F. Henry Habicht on 26 February.

EPA. 1992c. Supplemental Guidance to RAGS: Calculating the Concentration Term. Office of Solid Waste and Emergency Response. Washington, D.C. 9285.7-081. May.

EPA. 1991a. Supplemental Risk Assessment Guidance for Superfund. EPA Region X. August.

EPA. 1991b. Standard Default Exposure Factors (Handbook).

EPA, 1989a. Risk Assessment Guidance for Superfund. Volume I, Human Health Evaluation Manual, Part A. EPA/540/1-89/002.

EPA. 1989b. Update of Toxicity Equivalency Factors (TEFs) for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p- Dioxins and Dibenzofurans (CDDs/CDFs). Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. February.

Folmar, L.C., W.W. Dickoff, W.S. Zaugg, and H.O. Hodgins. 1982. The Effects of Aroclor 1254 and No. 2 Fuel Oil on Smoltification and Sea-Water Adaptation of Coho Salmon (*Oncorhynchus kisutch*). *Aquatic Toxicology 2:291-299.*

Hawkes, C.L., and L.A. Norris. 1977. Chronic Oral Toxicity of 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) to Rainbow Trout. *In* EPA (1993) Interim Report on 2,3,7,8-TCDD. *Trans. Amer. Fish. Soc. 106:641-645.*

Healey, M.C. 1982. Juvenile Pacific Salmon in Estuaries: The Life Support System. *In* V.S. Kennedy (ed.). *Estuarine Comparisons*. pp. 315-341. Academic Press, New York, NY.

Hogan, J.W., and J.L. Brauhn. 1975. Abnormal Rainbow Trout Fry from Eggs Containing High Residues of a PCB (Aroclor 1242). *Prog. Fish-Cult. 37:229-230.*

Hueckel, G., R. Buckley, and B. Benson. 1989. "Mitigating Rocky Habitat Loss Using Artificial Reefs." *Bulletin of Marine Science*, 44(2): 913 - 922.

IT Corp (International Technology Corporation). 1997. Draft Ecological Risk Assessment, Sediment Operable Unit, St. Louis River/Interlake/Duluth Tar Site, Duluth, Minnesota. Prepared for Minnesota Pollution Control Agency, St. Paul, MN. December.

Janz, D.M., and C.D. Metcalfe. 1991. Nonadditive Interactions of Mixtures of 2,3,7,8-TCDD and 3,3',4,4'-Tetrachlorobipheyl on Aryl Hydrocarbon Hydroxylase Induction in Rainbow Trout (*Oncorhynchus mykiss*). *In* EPA (1993) Interim Report on 2,3,7,8-TCDD. *Chemosphere 23:467-472.*

Johansson, N. 1970. PCB Indications of Effects on Fish. Proc. PCB Conference, Stockholm, Sweden, September 29, 1970. pp. 58-60.

Johnston, G. 1991. "Crabbing can be easy as wading your turn on Sound's tide flats." *Seattle Post-Intelligencer*, Section E, p. 1, 12 July 1991.

Kleeman, J.M., J.R. Olsen, and R.E. Peterson. 1988. Species Differences in 2,3,7,8-Tetrachlorodibenzo-p-dioxin Toxicity and Biotransformation in Fish. *Fund. Appl. Toxicol. 10:206-213.*

Kleeman, J.M., J.R. Olsen, S.M. Chen, and R.E. Peterson. 1986a. Metabolism and Disposition of 2,3,7,8-Tetrachlrodibenzo-p-dioxin in Rainbow Trout. *Toxicol. Appl. Pharmacol. 83:391-401.*

Kleeman, J.M., J.R. Olsen, S.M. Chen, and R.E. Peterson. 1986b. 2,3,7,8-Tetrachlrodibenzo-p-dioxin Metabolism and Disposition in Yellow Perch (*Perca flavescens*). *In* EPA (1993) Interim Report on 2,3,7,8-TCDD. *Toxicol. Appl. Pharmacol. 83:391-401.*

Liao, Shiquan, and Nayak Polissar. 1996. Results of Re-Analysis of the Tulalip and Squaxin Island Fish Consumption Data. Technical Memorandum. 30 September 1996.

Lieb, A.J., D.D. Bills, and R.O. Sinnhuber. 1974. Accumulation of Dietary Polychlorinated Biphenyls (Aroclor 1254) by Rainbow Trout (*Salmo gairdneri*). *J. Agric. Food Chem. 22:638-642.*

Mac, M.J., and T.R. Schwartz. 1992. Investigations into the Effects of PCB Congeners on Reproduction in Lake Trout from the Great Lakes. *Chemosphere 23(1-2):189-192.*

Mahlovich, M. 1992. Mukleshoot Tribe Fisheries Department. Personal conversation with T. Beierle, Roy F. Weston, Inc., Seattle, WA. 21 September.

Mehrle, P.M., D.R. Buckler, E.E. Little, L.M. Smith, J.D. Petty, P.H. Peterman, D.L. Stalling, G.M. DeGraeve, J.J. Coyle, and W.J. Adams. 1988. Toxicity and Bioconcentration of 2,3,7,8-Tetrachlorodibenzo-p-dioxin and 2,3,7,8-Tetrachlorodibenzofuran in Rainbow Trout. *In* EPA (1993) Interim Report on 2,3,7,8-TCDD. *Environ. Toxicol. Chem. 7:47-62.*

Melvin, D. 1991. Water Quality Specialist, Shellfish Program, Washington State Department of Health. Olympia, WA. Personal communications with R. Sturim, Roy F. Weston, Inc.. 3 June and 10 July.

Menzie, C.A., D.E. Burmaster, J.S. Freshman, and C.A. Callahan. 1992. Assessment of Methods for Estimating Ecological Risk in the Terrestrial Component: A Case Study at the Baird and McGuire Superfund Site in Holbrook, Massachusetts. *Environ. Toxicol. Chem. 11:245-260. In* Procedural Guidelines for Ecological Risk Assessments at U.S. Army Sites - Volume I. Edgewood Research, Development, and Engineering Center, Aberdeen Proving Ground, MD. December, 1994.

Meyer, J.H., T.A. Pearce, and S.B. Patlan. 1981. Distribution and Food Habitats of juvenile Salmonids in the Duwamish Estuary, Washington, 1980. Unpublished report to U.S. Army Corps of Engineers by U.S. Fish and Wildlife Service. Olympia, Washington, 42 p.

Monaco, M.E., et al. 1990. Distribution and Abundance of Fishes and Invertebrates in West Coast Estuaries, Volume 1: Data Summaries. ELMR Rpt. No. 4. Strategic Assessment Branch, NOS/NOAA. Rockville, MD. 240.

Muir, D. and G. Pastershank. 1994. Partitioning and Bioaccumulation of Di-, Tri-, Tetrachlorodibenzo-p-dioxins and -furans in a Riverine Environment. *In* Abstracts, 15th Annual Meeting. Society of Environmental Toxicology and Chemistry. Denver, CO. November 1994.

Muir, D.C.G., W.L. Fairchild, and D.M. Whittle. 1992. Predicting Bioaccumulation of Chlorinated Dioxins and Furans in Fish Near Canadian Bleached Kraft Mills. *Water Poll. R. Journal Canada* [as cited in EPA, 1993a.].

Niimi, A.J. 1983. Biological and Toxicological Effects of Environmental Contaminants in Fish and Their Eggs. Department of Fisheries and Oceans, Canada Centre for Inland Waters, Burlington, Ontario. L7R 4A6. *Can. J. Fish Aquat. Sci.* 40:306-312.

Nosho, T. 1991. Aquaculture Specialist, Sea Grant, University of Washington, Seattle, WA. Personal communications with R. Sturim, Roy F. Weston, Inc., 3 June and 10 July.

Parametrix (Parametrix, Inc.). 1994. Southwest Harbor Cleanup and Redevelopment Project, Draft Environmental Impact Statement. Prepared for: U.S. Army Corps of Engineers, WA Department of Ecology, and Port of Seattle. January, 1994.

Pfeifer, R. 1991. Seattle District Fish Biologist, Washington State Department of Wildlife, Mill Creek, WA. Personal communications with R. Sturim, Roy F. Weston, Inc., 10 July.

Pohl, R.J., J.R. Fouts, and J.R. Bend. 1975. Response of Hepatic and Renal Microsomal Mixed-Function Oxidases in the Littel Skate (*Raja erinacea*), and the Winter Flounder (*Pseudopleuronectes americanus*) to Pretreatment with TCDD (2,3,7,8-Tetrachlorodibenzo-p-dioxin) or DBA (1,2,3,4-Dibenzanthracene). *In* EPA (1993) Interim Report on 2,3,7,8-TCDD. *Bull. Mt. Desert Biol. Labs 15:64-66.*

Port of Seattle. 1997. Marine Facilities SW Harbor Project Terminal 5 Expansion Public Access, Construction Package (CP-10); 2/10/97 TM; 6/2/97 TM

PTI (PTI Environmental Services). 1995. Final Report: Analysis of BSAF Values for Nonpolar Organic Compounds in Finfish and Shellfish. Prepared for Washington Department of Ecology, Central Program, Environmental Review and Sediment Section, Olympia, Washington (CA0U-03-03). November, 1995.

PTI. 1991a. Reference Area Performance Standards for Puget Sound. EPA/910/9-91-041. September.

PTI. 1988. Briefing Report to the EPA Science Advisory Board: The Apparent Effects Threshold Approach. Prepared for Office of Puget Sound, Puget Sound Estuary Program, U.S. Environmental Protection Agency, Region 10, Seattle, WA. PTI Environmental Services, Bellevue, WA.

Puget Sound Estuary Program (PSEP). 1995. Recommended Guidelines for Conducting Laboratory Bioassays on Puget Sound Sediments. Revised Report. Prepared for U.S. Environmental Protection Agency, Region X, Office of Puget Sound, Seattle, WA. Revised by Puget Sound Water Quality Authority, Olympia, WA. July 1995.

Schink, D., K. McGraw, and K. Chew. 1983. Pacific Coast Clam Fisheries Technical Report. University of Washington, College of Ocean and Fishery Sciences, Washington Sea Grant Program, WSG 83-1. July.

Scholz, A. 1991. Resource Specialist, Washington State Department of Fisheries, Point Whitney Shellfish Laboratory, Brinnon, WA.. Personal communication with Rich Sturim, Project Scientist, Roy F. Weston, Inc. Seattle, Washington, July 11, 1991.

Simenstad, C.A., K.L Fresh, E.O. Salo. 1982. The Role of Puget Sound and Washington Coastal Estuaries in the Life History of Pacific Salmon: an Unappreciated Function. *In* V.S. Kennedy (ed.). Estuarine Comparisons. pp. 343-364. Academic Press, New York, NY. pp. 343-364.

Sol, S.Y., L.L. Johnson, T.K. Collier, M.M. Krahn, U. Varanasi. 1995. Contaminant Effects on Reproductive Output in North Pacific Flatfish. Proceedings of the International Symposium on North Pacific Flatfish, Alaska Sea Grant College Program. AK-SG-95-04.

Spitzburgen, J.M., J.M. Kleeman, and R.E. Peterson. 1988a. Morphologic Lesions and Acute Toxicity in Rainbow Trout (*Salmo gairdneri*) Treated with 2,3,7,8-Tetrachlorodibenzo-p-dioxin. *In* EPA (1993) Interim Report on 2,3,7,8-TCDD. J. *Toxicol. Environ. Health*. 23:333-358.

Spitzburgen, J.M., K.A. Schat, J.M. Kleeman, and R.E. Peterson. 1988b. 2,3,7,8-Tetrachlorodibenzo-p-dioxin Toxicity in Yellow Perch (*Perca flavescens*). *In* EPA (1993) Interim Report on 2,3,7,8-TCDD. J. Toxicol. Environ. Health. 23:359-383.

Spitzburgen, J.M., K.A. Schat, J.M. Kleeman, and R.E. Peterson. 1988c. Effects of 2,3,7,8-Tetracholodibenzo-p-dioxin (TCDD) or Aroclor 1254 on the Resistance of Rainbow Trout (*Salmo gairdneri*) Richardson, to Infectious Haematopoietic Necrosis Virus. *In* EPA (1993) Interim Report on 2,3,7,8-TCDD. J. Fish. Dis. 11:73-83.

Spitzburgen, J.M., M.K. Walker, J.R. Olsen, and R.E. Peterson. 1991. Pathological Alterations in Early Life Stages of Lake Trout (*Salvelinus namaycush*) Exposed to 2,3,7,8-Tetracholodibenzo-p-dioxin (TCDD) as Fertilized Eggs. *In* EPA (1993) Interim Report on 2,3,7,8-TCDD. Aquat. Toxicol. 19:41-72.

Spitzburgen, J.M., K.A. Schat, J.M. Kleeman, and R.E. Peterson. 1986. Interaction of 2,3,7,8-Tetracholodibenzo-p-dioxin (TCDD) with Immune Responses of Rainbow Trout. *In* EPA (1993) Interim Report on 2,3,7,8-TCDD. *Vet. Immunol. and Immunopathol.* 12:263-280.

Tetra Tech. 1988a. Elliott Bay Action Program: Evaluation of potential contaminant sources. Prepared for Washington State Department of Ecology and the U.S. EPA, Region 10 - Office of Puget Sound, Seattle, WA.

Toy, K.A., N.L. Polissar, S. Liao, and G.D. Mittelstaedt. 1996. A Fish Consumption Survey of the Tulalip and Squaxin Island Tribes of the Puget Sound Region. Tulalip Tribes, Department of Environment, Marysville, WA.

van der Weiden, M.E.J., J. van der Kolk, A.H. Penniks, W. Seinen, and M. van der Berg. 1990. A Dose/Response Study with 2,3,7,8-TCDD in the Rainbow Trout (*Oncorhynchus mykiss*). *In* EPA (1993) Interim Report on 2,3,7,8-TCDD. Chemosphere 20:1053-1058.

van der Weiden, M.E.J., J. van der Kolk, R. Bleumink, W. Seinen, and M. van der Berg. 1992. Concurrence of P450 1A1 Induction and Toxic Effects After Administration of a Low Dose of 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) to the Rainbow Trout (*Oncorhynchus mykiss*). *In* EPA (1993) Interim Report on 2,3,7,8-TCDD. Aquat. Toxicol. 24:123-142.

Walker, M.K., and R.E. Peterson. 1991. Potencies of Polychlorinated Dibenzo-p-dioxin, Dibenzofuran, and Biphenyl Congeners, Relative to 2,3,7,8-Tetrachlorodibenzo-p-dioxin, for Producing Early Life Stage Mortality in Rainbow Trout (*Oncorhynchus mykiss*). *In* EPA (1993) Interim Report on 2,3,7,8-TCDD. *Aquat. Toxicol.* 21:219-238.

Walker, M.K., L.C. Hufnagle, Jr., M.K. Clayton, and R.E. Peterson. 1982. An Egg Injection Method for Assessing Early Life Stage Mortality of Polychlorinated Dibenzo-p-dioxins, Dibenzofurans, and Biphenyls in Rainbow Trout (*Oncorhynchus mykiss*). *In* EPA (1993) Interim Report on 2,3,7,8-TCDD. *Aquat. Toxicol.* 22:15-38.

Walker, M.K., P.M. Cook, A.R. Batterman, D.B. Lothenback, C. Berini, L.C. Hufnagle, and R.E. Peterson. 1992. Early Life Stage Mortality Associated with Maternal Transfer of 2,3,7,8-Tetrachlorodibenzo-p-dioxin to Lake Trout Oocytes. *In* EPA (1993) Interim Report on 2,3,7,8-TCDD. U.S. Environmental Protection Agency, Environmental Research Laboratory, Duluth, MN. (In preparation).

Walker, M.K., Spitsbergen, J.M., J.R. Olson, and R.E. Peterson. 1991. 2,3,7,8-Tetracholodibenzo-p-dioxin (TCDD) Toxicity During Early Life Stage Development of Lake Trout (*Salvelinus namaycush*). *In* EPA (1993) Interim Report on 2,3,7,8-TCDD. *Can. J. Fish. Aquat. Sci.* 48:875-883.

Warner, E.J., and R.L. Fritz. 1995. The Distribution and Growth of Green River Chinook Salmon and Chum Salmon Outmigrants in the Duwamish Estuary as a Function of Water Quality and Substrate. Muckleshoot Indian Tribe, Fisheries Department, Water Resources Division, 39015 172nd Avenue, S.E., Auburn, WA, 98302.

WDNR (Washington State Department of Natural Resources). 1977. Washington Marine Atlas. Division of Marine Land Management. Volume 2. South Inland Waters.

WDOH (Washington State Department of Health). 1995. Tier I Report: Development of Sediment Quality Criteria for the Protection of Human Health. Environmental Health Assessment Section, Environmental Health Programs, Office of Toxic Substances, Olympia, Washington. June 1995.

WDOH. 1991. "Fourth Annual Inventory of Commercial and Recreational Shellfish Areas in Puget Sound", Shellfish Programs, Olympia, WA, June.

Weiss, L. 1997a. Washington State Department of Ecology. Personal communication with R. Doe, Roy F. Weston, Inc. 18 March.

Weiss, L. 1997b. Washington State Department of Ecology. Personal communication with C.. Chew, Roy F. Weston, Inc. 26 March.

Weitkamp, D.E., and T.H. Schadt. 1982. 1980 Juvenile Salmonid Study. Unpublished report by Parametrix, Inc. to Port of Seattle, Seattle, WA. 43p. plus appendices.

WESTON (Roy F. Weston, Inc.). 1998. Remedial Investigation Report, Pacific Sound Resources Marine Sediments Unit, Seattle, Washington. Prepared for U.S. Environmental Protection Agency, Region X, Seattle, WA. 23 March. WESTON. 1997a. Phase 2 Technical Memorandum, Pacific Sound Resources (PSR), Offshore Unit. Prepared for U.S. Environmental Protection Agency Region 10, Seattle, Washington. Roy. F. Weston, Seattle, Washington. April 1997.

WESTON. 1997b. Cruise Report (revised). Subtidal Surface Sediment Sampling, Fish Collection, Shallow and Deep Coring, Pacific Sound Resources, September through November 1996. January 1997.

WESTON. 1996a. Phase 1 Technical Memorandum, Pacific Sound Resources (PSR), Offshore Unit. Prepared for U.S. Environmental Protection Agency Region 10, Seattle, Washington. Roy. F. Weston, Seattle, Washington. August 1996.

WESTON. 1996b. RI/FS Work Plan, Pacific Sound Resources (PSR) Offshore Unit, Seattle, Washington. Prepared for the U.S. EPA, Region X, Seattle, WA. April 1996.

WESTON. 1996c. Sampling and Analysis Plan Phase 2 Addendum, Pacific Sound Resources (PSR) Offshore Unit, Seattle, Washington. Prepared for the U.S. EPA, Region X, Seattle, WA. November.

Williams, L.L., and J.P. Giesy. 1992. Relationships Among Concentrations of Individual Polychlorinated Biphenyl (PCB) Congeners, 2,3,7,8-Tetrachlorodibenzo-p-Dioxin Equivalents (TCDD-EQ), and Rearing Mortality of Chinook Salmon (*Oncorhynchus tshawytscha*) Eggs from Lake Michigan. *J Great Lakes Res. 18:108-124.*

Williams, R.W., R. Laramie, and J. Ames. 1975. A Catalog of Washington Streams and Salmon Utilization. Washington Department of Fisheries. Volume 1. Puget Sound. November.

Wisk, J.D., and K.R. Cooper. 1990b. The Stage Specific Toxicity of 2,3,7,8-Tetrachlorodibenzo-p-dioxin in Embryos of the Japanese Medaka (Oryzias latipes). *In* EPA (1993) Interim Report on 2,3,7,8-TCDD. *Environ. Toxicol. Chem. 9:1159-1169.*

Wood, W. 1991. Resource Specialist, Washington State Department of Fisheries, Point Whitney Shellfish Laboratory, Brinnon, WA. Personal communication with Rich Sturim, Project Scientist, Roy F. Weston, Inc., Seattle, Washington, July 10.

Zilfchke, Jay. 1992. Suquamish Tribe Fisheries Department. Conversation with Tom Beierle, Roy F. Weston, Inc. September 1992.

Zito, V., and R.L. Saunders. 1979. Effect of PCBs and Other Organochlorine Compounds on the Hatchability of Atlantic Salmon (*Salmo salar*) eggs. *Bull. Environ. Toxicol. 21:125-130.*

TABLE OF CONTENTS

TABLE OF CONTENTS *(Continued)*

TABLE OF CONTENTS *(Continued)*

ATTACHMENT K.1

BENTHIC INFAUNAL DATA

INVERTEBRATE SPECIES CHECKLIST
PSR Site, Elliott Bay, Seattle, WA
For R.F. Weston, Inc.
By Marine Taxonomic Services, Ltd.
March, 1997

Phylum Cnidaria
Class Anthozoa
Anthozoa sp. Indeterminate
Order Actiniaria
Nynantheae sp. Indeterminate
Order Ceriantharia
Family Cerianthidae
Pachycerianthus fimbriatus (McMurrich, 1910)
Phylum Platyhelminthes
Platyhelminthes sp. Indeterminate
Class Turbellaria
Turbellaria sp. Indeterminate
Phylum Nemertea
Nemertea sp. Indeterminate
Phylum Nematoda
Nematoda sp. Indeterminate
Phylum Annelida
Class Polychaeta
Order Orbiniida
Family Orbiniidae
Phylo felix Kinberg, 1866
Leitoscoloplos pugettensis (Johnson, 1901)
Family Paraonidae
Aricidea (Acmira) lopezi Berkeley & Berkeley, 1956
Aricidea (Allia) ramosa (Annenkova, 1934)
Levinsenia gracilis (Tauber, 1879)
Order Cossurida
Family Cossuridae
Cossura sp. Indeterminate/Juvenile
Order Spionida
Family Apistobranchidae
Apistobranchus ornatus Hartman, 1965
Family Spionidae
Boccardiella hamata (Webster, 1879)
Laonice cirrata (Sars, 1851)
Paraprionospio pinnata (Ehlers, 1901)
Dipolydora akaina Blake, 1996
Dipolydora socialis (Schmarda, 1861)
Dipolydora cardalia (Berkeley, 1927)
Polydora caulleryi (Mesnil, 1897)
Polydora limicola Annenkova, 1934
Polydora sp. Indeterminate/Juvenile
Prionospio (Prionospio) jubata Blake, 1996
Prionospio (Minuspio) lighti Maceolek, 1985
Prionospio (Minuspio) multibranchiata Berkeley, 1927
Prionospio sp. Indeterminate/Juvenile
Scolelepis texana Foster, 1971

Spio cirrifera (Banse and Hobson, 1968)
Spionidae sp. Indeterminate/Juvenile
Spiophanes berkeleyorum Pettibone, 1962
Spiophanes bombyx (Claparede, 1870)
Family Magelonidae
Magelona longicornis Johnson, 1901
Magelona sp. Juvenile
Family Trochochaetidae
Trochochaeta multisetosa (Oersted, 1844)
Family Chaetopteridae
Chaetopteridae sp. Indeterminate
Chaetopterus nr. variopedatus (Renier, 1804)
Mesochaetopterus taylori Potts, 1914
Phyllochaetopterus prolifica Potts, 1914
Spiochaetopterus costarum (Claparede, 1870)
Family Cirratulidae
Aphelochaeta monilaris (Hartman, 1960)
Aphelochaeta sp. 2
Aphelochaeta sp. Indeterminate
Aphelochaeta sp. N-1
Caulleriella pacifica Berkeley, 1929
Chaetozone acuta Banse and Hobson, 1969
Chaetozone nr. setosa Malmgren, 1867
Chaetozone sp. Indeterminate
Cirratulidae sp. Indeterminate/Juvenile
Cirratulus spectabilis (Kinberg, 1866)
Monticellina serratiseta (Banse & Hobson, 1968)
Monticellina sp. A
Monticellina sp. Indeterminate
Tharyx sp. Indeterminate
Order Capitellida
Family Capitellidae
Barantolla americana Hartman, 1963
Capitella capitata 'hyperspecies'
Capitellidae sp. Indeterminate/Juvenile
Heteromastus filobranchus Berkeley & Berkeley, 1932
Mediomastus ambiseta (Hartman, 1947)
Mediomastus californiensis Hartman, 1944
Mediomastus sp. Indeterminate
Notomastus latericeus Sars, 1851
Notomastus (Clistomastus) tenuis Moore, 1909
Family Maldanidae
'Clymenura' gracilis Hartman, 1969
Euclymeninae sp. Indeterminate/Juvenile
Issocirrus longiceps (Moore, 1923)
Maldane sarsi Malmgren, 1865
Maldanidae sp. Indeterminate/Juvenile
Maldaninae sp. Indeterminate
Metasychis disparadentata (Moore, 1904)
Nicomache personata Johnson, 1901
Notoproctus pacificus (Moore, 1906)
Praxillella pacifica Berkeley, 1929
Praxillella gracilis (M. Sars, 1861)
Praxillella sp. Indeterminate

Rhodine bitorquata Moore, 1923
Order Opheliida
Family Opheliidae
Armandia brevis (Moore, 1906)
Ophelina acuminata Oersted, 1843
Travisia forbesii Johnston, 1840
Travisia sp. Juvenile
Family Scalibregmidae
Asclerocheilus beringianus Ushakov, 1955
Scalibregma inflatum Rathke, 1843
Order Phyllodocida
Family Phyllodocidae
Eteone sp. Indeterminate
Eulalia californiensis (Hartman, 1936)
Eulalia nr. levicornuta Moore, 1909
Eulalia sp. 1
Eumida longicornuta (Moore, 1909)
Phyllodoce (Anaitides) groenlandica Oersted, 1843
Phyllodoce (Aponaitides) hartmanae Blake and Walton, 1977
Phyllodoce (Anaitides) williamsi (Hartman, 1936)
Phyllodoce sp. Juvenile
Family Aphroditidae
Aphrodita japonica Marenzeller, 1879
Aphrodita sp. Juvenile
Family Polynoidae
Gattyana ciliata Moore, 1902
Gattyana cirrosa (Pallas, 1766)
Harmothoe fragilis (Moore, 1910)
Harmothoe imbricata (Linnaeus, 1767
Lepidasthenia berkeleyae Pettibone, 1948
Lepidasthenia longicirrata Berkeley, 1923
Lepidasthenia sp. Indeterminate/Juvenile
Lepidonotus spiculus (Treadwell, 1906)
Malmgreniella bansei Pettibone, 1993
Malmgreniella berkeleyorum Pettibone, 1993
Malmgreniella liei Pettibone, 1993
Malmgreniella sp. Juvenile
Polynoidae sp. Indeterminate
Tenonia priops (Hartman, 1961)
Family Pholoididae
Pholoides asperus (Johnson, 1897)
Family Sigalionidae
Pholoe glabra Hartman, 1961
Pholoe sp. Indeterminate
Sthenalais tertiaglabra Moore, 1910
Family Chrysopetalidae
Paleanotus bellis (Johnson, 1897)
Family Hesionidae
Hesionidae sp. Indeterminate/Juvenile
Microphthalmus sp. Indeterminate
Micropodarke dubia (Hessle, 1925)
Podarke pugettensis Johnson, 1901
Podarkeopsis glabrus (Hartmann-Schroder, 1959)
Family Pilargidae

Parandalia fauveli (Berkeley & Berkeley, 1941)
Pilargis maculata Hartman, 1947
Sigambra sp. Juvenile
Sigambra tentaculata (Treadwell, 1941)
Family Syllidae
Autolytinae sp. Indeterminate
Ehlersia heterochaeta Moore, 1909
Ehlersia hyperioni Dorsey & Phillips, 1987
Eusyllis habei Imajima, 1966
Exogone lourei Berkeley and Berkeley, 1938
Exogone molesta Banse, 1972
Odontosyllis phosphorea Moore, 1909
Pionosyllis uraga Imajima, 1966
Procerea cornuta (Agassiz, 1863)
Sphaerosyllis ranunculus Kudenov & Harris, 1995
Syllidae sp. Indeterminate/Juvenile
Typosyllis harti (Berkeley & Berkeley, 1942)
Family Nereidae
Nereis procera Ehlers, 1868
Nereis sp. Juvenile
Nereis zonata Malmgren, 1867
Platynereis bicanaliculata (Baird, 1863)
Family Glyceridae
Glycera americana Leidy, 1855
Glycera nana Johnson, 1901
Family Goniadidae
Glycinde armigera Moore, 1911
Glycinde polygnatha Hartman, 1950
Goniada maculata Oersted, 1843
Family Nephtyidae
Nephtys cornuta Berkeley & Berkeley, 1945
Nephtys ferruginea Hartman, 1940
Nephtys sp. Indeterminate/Juvenile
Family Sphaerodoridae
Sphaerodoropsis sphaerulifer (Moore, 1909)
Order Eunicida
Family Onuphidae
Diopatra ornata Moore, 1911
Epidiopatra hupferiana monroi Day, 1967
Onuphidae sp. Indeterminate/Juvenile
Onuphis (Nothria) elegans (Johnson, 1901)
Onuphis (Nothria) iridescens (Johnson, 1901)
Onuphis sp. Juvenile
Family Lumbrineridae
Eranno bicirrata (Treadwell, 1929)
Lumbrineridae sp. Indeterminate/Juvenile
Lumbrineris californiensis Hartman, 1944
Lumbrineris cruzensis Hartman, 1944
Lumbrineris limicola Hartman, 1944
Lumbrineris sp. Indeterminate
Scoletoma luti (Berkeley & Berkeley, 1945)
Family Arabellidae
Drilonereis falcata Moore, 1911
Drilonereis longa Webster, 1879

Notocirrus californiensis Hartman, 1944

Family Dorvilleidae

Dorvillea pseudorubrovittata Berkeley, 1927

Dorvillea rudolphi (delle Chiaje, 1828)

Dorvillea sp. Indeterminate

Dorvilleidae sp. Indeterminate

Parougia caeca (Webster and Benedict, 1884)

Protodorvillea gracilis (Hartman, 1938)

Order Sternaspida

Family Sternaspidae

Sternaspis scutata (Renier, 1807)

Order Oweniidae

Family Oweniidae

Galathowenia oculata Zachs, 1923

Myriochele heeri Malmgren, 1867

Owenia fusiformis delle Chiaje, 1844

Order Flabelligerida

Family Flabelligeridae

Pherusa plumosa (Muller, 1776)

Order Terebellida

Family Sabellariidae

Idanthyrsus saxicavus (Baird, 1863)

Neosabellaria cementarium (Moore, 1906)

Family Pectinariidae

Pectinaria californiensis Hartman, 1941

Pectinaria granulata (Linnaeus, 1767)

Pectinaria sp. Juvenile

Family Ampharetidae

Amage anops (Johnson, 1901)

Ampharete finmarchica (Sars, 1865)

Ampharete labrops Hartman, 1961

Ampharete nr. crassiseta Annenkova, 1929

Ampharete sp. Indeterminate/Juvenile

Ampharetidae sp. Indeterminate/Juvenile

Amphicteis mucronata Moore, 1923

Anobothrus gracilis (Malmgren, 1866)

Asabellides lineata (Berkeley & Berkeley, 1943)

Schistocomus hiltoni Chamberlin, 1919

Family Terebellidae

Amphitrite edwardsi (Quatrefages, 1865)

Amphitrite robusta Johnson, 1901

Artacama coniferi Moore, 1905

Betapista dekkerae Banse, 1980

Lanassa nordenskioldi Malmgren, 1866

Lanassa sp. Indeterminate

Lanassa venusta (Malm, 1874)

Pista bansei Saphronova, 1988

Pista brevibranchiata Moore, 1923

Pista elongata Moore, 1909

Pista sp. Juvenile

Polycirrus californicus Moore, 1909

Polycirrus sp. complex

Proclea graffii (Langerhans, 1884)

Scionella japonica Moore, 1903

Streblosoma bairdi Malmgren, 1866
Streblosoma sp. Juvenile
Terebellidae sp. Indeterminate/Juvenile
Thelepus setosus (Quatrefages, 1865)
Family Trichobranchidae
Artacamella hancocki Hartman, 1955
Terebellides californica Williams, 1984
Order Sabellida
Family Sabellidae
Bispira sp. Indeterminate
Chone duneri Malmgren, 1867
Chone sp. Indeterminate
Euchone incolor Hartman, 1965
Megalomma splendida (Moore, 1905)
Myxicola infundibulum (Renier, 1804)
Pseudopotamilla myriops (Marenzeller, 1884)
Pseudopotamilla neglecta (Sars, 1851)
Sabellidae sp. Indeterminate/Juvenile
Class Oligochaeta
Oligochaeta sp. Indeterminate
Class Hirudinoidea
Hirudinea sp. Indeterminate
Phylum Mollusca
Class Aplacophora
Order Chaetodermatida
Family Chaetodermatidae
Chaetoderma sp. Indeterminate
Class Gastropoda
Gastropoda sp. Juvenile
Order Archaeogastropoda
Family Trochidae
Margarites pupillus (Gould, 1849)
Order Mesogastropoda
Family Rissoidae
Alvania compacta (Carpenter, 1864)
Cingula sp. Indeterminate
Family Vitrinellidae
Vitrinella columbiana Bartsch, 1921
Family Cerithiidae
Lirobittium sp. Indeterminate
Family Calyptraeidae
Crepipatella lingulata (Gould, 1846)
Family Trichotropidae
Trichotropis cancellata Hinds, 1843
Family Naticidae
Cryptonatica affinis (Gmelin, 1791)
Euspira lewisii (Gould, 1847)
Family Eulimidae
Balcis sp. Indeterminate
Vitreolina columbiana (Bartsch, 1917)
Order Neogastropoda
Family Muricidae
Boreotrophon sp. Indeterminate
Ceratostoma foliatum (Gmelin 1791)

Family Columbellidae
Astyris gausapata (Gould, 1850)
Family Nassariidae
Nassarius mendicus (Gould, 1849)
Family Turridae
Kurtzia arteaga (Dall & Bartsch, 1910)
Subclass Opistobranchia
Family Pyramidellidae
Odostomia sp. Indeterminate
Turbonilla sp. Indeterminate
Order Cephalaspidea
Family Acteonidae
Rictaxis punctocaelatus (Carpenter, 1864)
Family Retusidae
Retusa sp. Indeterminate
Family Gastropteridae
Gastropteron pacificum Bergh, 1894
Family Cylichnidae
Cylichna attonsa (Carpenter, 1865)
Order Nudibranchia
Nudibranchia sp. Indeterminate
Suborder Aeoloidea
Aeolidacea sp. 1
Aeolidacea sp. 2
Class Bivalvia
Bivalvia sp. Juvenile
Order Nuculoida
Family Nuculidae
Acila castrensis (Hinds, 1843)
Nucula tenuis (Montagu, 1808)
Family Nuculanidae
Nuculana minuta (Fabricius, 1776)
Nuculana sp. Indeterminate
Yoldia scissurata Dall, 1897
Yoldia sp. Juvenile
Order Mytiloida
Family Mytilidae
Megacrenella columbiana (Dall, 1897)
Musculus discors (Linnaeus, 1767)
Musculus sp. Juvenile
Mytilidae sp. Juvenile
Mytilis sp. Juvenile
Order Ostreoida
Family Pectinidae
Chlamys hastata (Sowerby, 1842)
Delectopecten sp. Juvenile
Delectopecten vancouverensis (Whiteaves, 1893)
Order Veneroida
Family Lucinidae
Lucinoma annulatum (Reeve, 1850)
Parvalucina tenuisculpta (Carpenter, 1864)
Family Thyasiridae
Adontorhina cyclia Berry, 1947
Axinopsida serricata (Carpenter, 1864)

Thyasira gouldii (Phillipi, 1845)
Family Montacutidae
Mysella tumida (Carpenter, 1864)
Family Carditidae
Cyclocardia ventricosa (Gould, 1850)
Order galeommatacea
Galeommatacea sp. Indeterminate
Family Astartidae
Astarte elliptica (T. Brown, 1827)
Family Cardiidae
Cardiidae sp. Juvenile
Clinocardium nuttalli (Conrad, 1837)
Clinocardium sp. Juvenile
Nemocardium centrifilosum (Carpenter, 1864)
Family Mactridae
Mactridae sp. Juvenile
Family Solenidae
Solen sicarius Gould, 1850
Family Tellinidae
Macoma calcarea (Gmelin, 1791)
Macoma carlottensis Whiteaves, 1880
Macoma elimata Dunnill and Coan, 1968
Macoma moesta alaskana (Deshayes, 1855)
Macoma nasuta (Conrad, 1837)
Macoma obliqua (Sowerby, 1817)
Macoma sp. Juvenile
Macoma yoldiformis Carpenter, 1864
Tellina sp. Juvenile
Family Veneridae
Compsomyax subdiaphanus (Carpenter, 1864)
Psephidia lordi (Baird, 1863)
Order Myoida
Family Myidae
Mya arenaria Linnaeus, 1758
Family Hiatellidae
Hiatella arctica (Linnaeus, 1767)
Family Teredinidae
Teredinidae sp. Indeterminate
Order Pholadomyoida
Family Pandoridae
Pandora filosa (Carpenter, 1864)
Pandora sp. Juvenile
Family Lyonsiidae
Lyonsia californica Conrad, 1837
Family Thraciidae
Thracia trapezoides Conrad, 1849
Order Septibranchia
Family Cuspidariidae
Cardiomya californica (Dall, 1886)
Phylum Arthropoda
Subphylum Crustacea
Class Ostracoda
Subclass Myodocopa
Order Myodocopida

Suborder Myodocopina
Superfamily Cypridinoidea
Family Philomedidae
Euphilomedes carcharodonta (Smith, 1952)
Euphilomedes producta Poulsen, 1962
Euphilomedes sp. Indet.
Family Cylindroleberididae
Parasterope barnesi Baker, 1978
Family Rutidermatidae
Rutiderma lomae (Juday, 1907)
Class Copepoda
Order Cyclopoida
Cyclopoida sp. Indeterminate
Class Cirripedia
Order Thoracica
Suborder Balanomorpha
Balanomorpha sp. Indeterminate
Superfamily Balanoidea
Family Archaeobalanidae
Solidobalanus hesperius (Pilsbry, 1916)
Class Malacostraca
Subclass Phyllocarida
Order Leptostraca
Family Nebaliidae
Nebalia "pugettensis" species complex
Subclass Eumalacostraca
Order Mysidacea
Suborder Mysida
Family Mysidae
Mysidae sp. Indeterminate
Mysidella americana Banner, 1948
Order Cumacea
Family Leuconidae
Eudorella pacifica Hart, 1931
Eudorellopsis longirostris Given, 1961
Leucon sp. A Myers & Benedict, 1974 (provisional species)
Family Nannastacidae
Camplyaspis hartae Lie, 1969
Camplyaspis rubromaculata Lie, 1971
Family Diastylidae
Diastylis paraspinulosa Zimmer, 1926
Diastylis "santamariensis" Watling & McCann, known, not published
Order Tanaidacea
Suborder Tanaidomorpha
Superfamily Paratanaoidea
Family Paratanaidae
Leptochelia dubia (Kroyer, 1842)
Family Leptognathiidae
Araphura sp. A SCAMIT 1987 provisional species
Leptognatha gracilis (Kroyer, 1842)
Leptognathia sp. E SCAMIT 1985 provisional species
Family Anarthuridae
Scoloura phillipsi Sieg & Dojiri, 1991
Order Isopoda

Suborder Anthuridea
Family Anthuridae
Haliophasma geminata Menzies and Barnard, 1959
Suborder Flabellifera
Superfamily Cirolanoidea
Family Limnoriidae
Limnoria lignorum (Rathke, 1799)
Suborder Asellota
Superfamily Janiroidea
Family Munnidae
Munna fernaldi George & Stromberg, 1968
Family Paramunnidae
Munnogonium tillerae Menzies & Barnard, 1959
Pleurogonium californiense Menzies, 1951
Pleurogonium rubicundum (G. O. Sars, 1864)
Order Amphipoda
Suborder Gammaridea
Superfamily Pontogeneiidea
Family Eusiridae
Eusirus columbianus Bousfield & Hendrycks, 1995
Superfamily Oediceratoidea
Family Oedicerotidae
Deflexilodes enigmaticus Bousfield & Chevrier, 1996
Eochelidium sp. A SCAMIT, 1997 provisional species
Synchelidium pectinatum Bousfield & Chevrier, 1996
Synchelidium rectipalmum Mills, 1962
Synchelidium sp. Indeterminate
Westwoodilla caecula (Bate, 1857)
Superfamily Leucothoidea
Family Pleustidae
Pleusymtes sp. A Cadien, 1994 provisional species
Superfamily Phoxocephaloidea
Family Phoxocephalidae
Eobrolgus chumashi J.L & C.M. Barnard, 1981
Eyakia robusta (Holmes, 1908)
Heterphoxus conlanae Jarrett & Bousfield, 1994
Heterophoxus sp. Indeterminate
Metaphoxus frequens Barnard, 1960
Parametaphoxus quaylei Jarrett & Bousfield, 1994
Superfamily Lysianassoidea
Family Lysianassidae
Cyphocaris challengeri Stebbing, 1888
Hippomedon sp. A (Diener, 1990)
Orchomene decipiens (Hurley, 1963)
Orchomene pacificus (Gurjanova, 1938)
Orchomene pinguis (Boeck, 1861)
Pachynus barnardi Hurley, 1963
Prachynella lodo J.L. Barnard, 1964
Superfamily Pardaliscoidea
Family Pardaliscidae
Pardalisca tenuipes G.O. Sars, 1895
Superfamily Ampeliscoidea
Family Ampeliscidae
Ampelisca agassizi (Judd, 1896)

Ampelisca brevisimulata J.L. Barnard, 1954
Ampelisca careyi Dickinson, 1982
Ampelisca hancocki J.L. Barnard, 1954
Ampelisca lobata Holmes, 1908
Byblis millsi Dickinson, 1983
Superfamily Melphidippoidea
Family Melphidippidae
Melphisana "bola" species complex
Family Melitidae
Desdimelita desdichada (J.L. Barnard, 1964)
Desdimelita transmelita Jarrett & Bousfield, 1996
Superfamily Corophioidea
Family Isaeidae
Photis brevipes Shoemaker, 1942
Photis macrotica J.L. Barnard, 1962
Photis sp. Indeterminate
Protomedeia prudens J.L. Barnard, 1966
Protomedeia sp. Indeterminate
Family Ischyroceridae
Ericthonius brasiliensis (Dana, 1853)
Ericthonius rubricornis (Stimpson, 1853)
Microjassa litotes J.L. Barnard, 1954
Family Aoridae
Aoroides intermedia Conlan and Bousfield, 1982
Aoroides sp. Indeterminate
Family Corophiidae
Corophium baconi Shoemaker, 1934
Corophium insidiosum Crawford, 1937
Family Podoceridae
Dyopedos monacanthus (Metzger, 1875)
Suborder Caprellidea
Superfamily Caprelloidea
Family Aeginellidae
Mayerella banksia Laubitz, 1970
Family Caprellidae
Caprella mendax Mayer, 1903
Metacaprella anomola (Mayer, 1903)
Order Decapoda
Suborder Caridea
Superfamily Alpheoidea
Family Hippolytidae
Eualus sp. Indeterminate
Heptacarpus brevirostris (Dana, 1852)
Hippolytidae sp. Indeterminate
Spirontocaris sp. Indeterminate
Superfamily Crangonoidea
Family Crangonidae
Crangon alaskensis (Lockington, 1877)
Crangon sp. Indeterminate
Mesocrangon munitella (Walker, 1898)
Suborder Reptantia
Family Callianassidae
Neotrypaea sp. Indeterminate
Family Upogebiidae

Upogebia pugettensis (Dana, 1852)
Family Paguridae
Discorsopagurus schmitti (Stevens, 1925)
Pagurus sp. Indeterminate
Family Majidae
Majidae sp. Indeterminate
Oregonia gracilis Dana, 1851
Family Cancridae
Cancer gracilis Dana, 1852
Cancer sp. Indeterminate
Family Xanthidae
Lophopanopeus sp. Indeterminate
Family Pinnotheridae
Pinnixa occidentalis Rathbun, 1893
Pinnixa schmitti Rathbun, 1918
Pinnixa sp. Indeterminate
Pinnotheridae sp. Indeterminate
Phylum Echiura
Order Echiuroinea
Family Thalassematidae
Arhynchite pugettensis Fisher, 1947
Phylum Sipuncula
Family Golfingiidae
Golfingia sp. Indeterminate
Sipunculida sp. Indeterminate
Thysanocardia nigra (Ikeda, 1904)
Phylum Phoronida
Family Phoronidae
Phoronida sp. Indeterminate
Phoronis sp. Indeterminate
Phylum Brachiopoda
Brachiopoda sp. Juvenile
Phylum Echinodermata
Class Asteroidea
Asteroidea sp. Juvenile
Order Spinulosida
Family Solasteridae
Solasteridae sp. Indeterminate
Class Ophiuroidea
Order Ophiurida
Ophiurida sp. Indeterminate
Family Amphiuridae
Amphiodia periercta A. L. Clark, 1911
Amphiodia sp. Indetermiante
Amphipholis sp. Indeterminate
Amphipholis squamata (Delle Chiaje, 1828)
Amphiuridae sp. Indeterminate
Family Ophiuridae
Ophiura lutkeni (Lyman, 1860)
Ophiura sp. Indeterminate
Class Holothuroidea
Order Dendrochirotida
Dendrochirotida sp. Indeterminate
Family Phyllophoridae

Pentamera cf. pseudopopulifera Deichmann, 1938
Pentamera sp. Indeterminate
Pentamera trachyplaca (H. L. Clark, 1924)
Family Cucumariidae
Cucumaria piperata (Stimpson, 1864)
Cucumaria sp. Indeterminate
Order Apodida
Family Synaptidae
Leptosynapta clarki Heding, 1928
Leptosynapta transgressor Heding, 1928
Family Chiridotidae
Chiridota sp. Indeterminate

VOUCHER COLLECTION

VOUCHER COLLECTION
PSR SITE, ELLIOTT BAY, SEATTLE, WA
For R.F. Weston, Inc.
By Marine Taxonomic Services, Ltd.
March, 1997

Vial #	POLYCHAETA	Station	Count
1	Amage anops	2545 A	1
2	Ampharete labrops	2534 D	1
3	Ampharete nr. crassiseta	2545 D	1
4	Amphicteis mucronata	2545 A	1
5	Amphitrite edwardsi	2529 E	1
6	Anobothrus gracilis	2545 A	1
7	Aphelochaeta monilaris	2543 E	1
8	Aphrodita japonica	2529 B	1
9	Aphrodita sp. Juv.	2546 B	1
10	Apistobranchus ornatus	2529 E	1
11	Aricidea lopezi	2545 C	1
12	Armandia brevis	2526 A	1
13	Artacama coniferi	2535 B	1
14	Artacamella hancocki	2545 C	1
15	Asabellides lineata	2545 A	1
16	Aschelocheilus beringianus	2545 A	1
17	Autolytinae sp. Indet.	2546 B	2
18	Barantolla americana	2529 D	1
19	Barantolla sp. Juv.	2529 D	1
20	Barantolla sp. Juv.	2529 E	1
21	Betapista dekkarae	2541 B	1
22	Betapista dekkerae	2545 A	1
23	Bispira sp. Indet.	2545 A	2
24	Bispira sp. Indet.	2545 C	1
25	Boccardiella hamata	2533 C	1
26	Capitella capitata 'hyperspecies'	2526 D	2
27	Caulleriella pacifica	2545 A	2
28	Chaetopterus nr. variopedatus	2545 D	1
29	Chaetozone acuta	2537 C	1
30	Chaetozone nr. setosa	2534 B	1
31	Tharyx sp. Indet.	2533 E	1
32	Chone duneri	2545 C	1
33	Chone sp. Indet.	2545 D	1
34	Cirratulidae sp. Indet.	2545 A	3
35	Cirratulidae sp. Indet.	2526 B	1
36	Cirratulus sp. Juv.	2537 B	2
37	'Clymenura' gracilis	2546 B	1
38	'Clymenura' gracilis	2533 A	1
39	Cossura pygodactylata	2526 B	1
40	Cossura sp. Indet.	2526 C	1
41	Dipolydora akaina	2545 E	2
42	Dipolydora akaina	2545 A	1
43	Dipolydora cardalia	2526 A	1
44	Dipolydora socialis	2545 B	1
45	Dorvillea pseudorubrovittata	2541 C	1
46	Dorvillea rudolphi	2545 B	1
47	Dorvilleidae sp. Indet.	2529 A	1
48	Drilonereis longa	2526 A	1
49	Drilonereis longa	2545 D	1
50	Ehlersia heterochaeta	2545 A	2
51	Ehlersia hyperioni	2545 A	1
52	Epidiopatra hupferiana monroi	2545 C	1
53	Epidiopatra hupferiana monroi	2537 B	1

VOUCHER COLLECTION
PSR SITE, ELLIOTT BAY, SEATTLE, WA
For R.F. Weston, Inc.
By Marine Taxonomic Services, Ltd.
March, 1997

Vial #		Station	Count
54	Errano bicirrata	2545 A	1
55	Eteone sp. Indet.	2526 A	1
56	Euchone incolor	2534 A	1
57	Eulalia californiensis	2541 A	1
58	Eulalia californiensis	2545 A	1
59	Eulalia sp. 1	2545 B	1
60	Eulalia nr. levicornuta	2529 A	1
61	Eusyllis habei	2545 B	3
62	Pionosyllis uraga	2545 A	1
63	Exogone lourei	2529 E	1
64	Galathowenia oculata	2535 D	1
65	Gattyana ciliata	2545 A	1
66	Gattyana ciliata	2545 B	1
67	Gattyana cirrosa	2529 E	2
68	Gattyana cirrosa	2545 A	1
69	Gattyana cirrosa	2545 E	1
70	Gattyana cirrosa	2537 D	1
71	Glycera americana	2531 B	1
72	Glycera nana	2545 A	1
73	Glycinde armigera	2534 B	1
74	Harmothoe fragilis	2545 C	1
75	Heteromastus filobranchus	2541 A	1
76	Idanthyrsus saxicavus	2541 B	1
77	Idanthyrsus saxicavus	2541 D	1
78	Isocirrus longiceps	2541 D	2
79	Euclymeninae sp. Indet.	2545 A	1
80	Lanassa nordenskolki	2546 A	1
81	Lanassa venusta	2529 A	1
82	Laonice cirrata	2545 A	1
83	Leitoscoloplos pugettensis	2526 A	1
84	Lepidasthenia longicirrata	2545 A	1
85	Lepidasthenia berkeleyae	2543 C	1
86	Lepidasthenia longicirrata	2529 E	1
87	Lepidasthenia sp. Juv.	2545 B	1
88	Lepidonotus spiculus	2545 A	1
89	Levinsenia gracilis	2526 C	1
90	Lumbrineris californiensis	2545 A	1
91	Lumbrineris cruzensis	2545 A	2
92	Magelona longicornis	2545 A	1
93	Maldaninae sp. Indet.	2531 E	1
94	Malmgreniella bansei	2533 E	1
95	Malmgreniella bansei	2546 C	1
96	Malmgreniella berkeleyorum	2545 D	2
97	Malmgreniella berkeleyorum	2545 C	1
98	Malmgreniella liei	2535 E	1
99	Mediomastus ambiseta	2529 C	1
100	Mediomastus californiensis	2526 C	1
101	Mediomastus californiensis	2526 E	2
102	Megalomma splendida	2545 A	1
103	Mesochaetopterus taylori	2541 A	2
104	Microphthalmus sp. Indet.	2526 A	4
105	Microphthalmus sp. Indet.	2534 B	1
106	Monticellina serriseta	2529 D	2
107	Monticellina serriseta	2534 A	2

VOUCHER COLLECTION
PSR SITE, ELLIOTT BAY, SEATTLE, WA
For R.F. Weston, Inc.
By Marine Taxonomic Services, Ltd.
March, 1997

Vial #		Station	Count
108	Monticellina serriseta	2526 C	1
109	Monticellina sp. A	2529 E	2
110	Myriochele heeri	2534 B	3
111	Myxicola infundibula	2545 A	2
112	Neosabellaria cementarium	2545 A	1
113	Nephtys cornuta	2526 C	1
114	Nephtys ferruginea	2529 D	1
115	Nereis procera	2543 A	1
116	Nicomache personata	2545 A	1
117	Notocirrus californiensis	2529 C	1
118	Notomastus latericius	2545 A	1
119	Notomastus tenuis	2545 A	1
120	Notoproctus pacificus	2545 A	1
121	Odontosyllis phosphorea	2545 A	1
122	Onuphis elegans	2543 E	1
123	Onuphis iridescens	2545 A	1
124	Ophelina acuminata	2545 A	1
125	Owenia fusiformis	2533 D	1
126	Paleonotus bellis	2545 A	1
127	Parandalia fauveli	2526 C	1
128	Paraprionospio pinnata	2545 A	1
129	Pectinaria californiensis	2526 C	1
130	Pectinaria granulata	2541 A	2
131	Pherusa plumosa	2545 A	1
132	Pholoe sp. Indet.	2531 E	1
133	Pholoe glabra	2533 D	1
134	Pholoe sp. Indet.	2529 D	1
135	Pholoides aspera	2545 A	2
136	Phyllochaetopterus prolifica	2545 A	2
137	Phyllodoce groenlandica	2543 E	1
138	Phyllodoce hartmanae	2529 E	1
139	Phyllodoce groenlandica	2541 C	1
140	Phylo felix	2535 A	1
141	Pilargis maculata	2526 C	1
142	Pista bansei	2545 A	1
143	Pista brevibranchiata	2545 A	1
144	Pista elongata	2545 A	2
145	Platynereis bicanaliculata	2529 E	1
146	Podarke pugettensis	2541 D	1
147	Podarkeopsis glabrus	2535 D	1
148	Polycirrus californicus	2534 D	1
149	Polycirrus californicus	2535 E	1
150	Polydora limicola	2529 E	1
151	Praxillella gracilis	2537 A	1
152	Praxillella pacifica	2531 E	1
153	Praxillella pacifica	2529 A	1
154	Prionospio jubata	2526 C	1
155	Prionospio lighti	2529 D	1
156	Prionospio multibranchiata	2529 A	1
157	Procerea cornuta	2529 A	1
158	Proclea graffi	2545 A	1
159	Protodorvillea gracilis	2537 A	1
160	Pseudopotamilla myriops	2537 E	1
161	Rhodine bitorquata	2545 A	1

VOUCHER COLLECTION
PSR SITE, ELLIOTT BAY, SEATTLE, WA
For R.F. Weston, Inc.
By Marine Taxonomic Services, Ltd.
March, 1997

Vial #		Station	Count
162	Scalibregma inflatum	2545 C	1
163	Schistocomus hiltoni	2545 A	1
164	Scionella japonica	2545 A	1
165	Scolelepis texana	2545 B	1
166	Scoletoma luti	2526 C	1
167	Sigambra tentaculata	2541 A	1
168	Sphaerodoropsis sphaerulifer	2534 B	2
169	Spio cirrifera	2526 C	1
170	Spiochaetopterus costarum	2526 C	1
171	Spiophanes berkeleyorum	2545 A	1
172	Spiophanes bombyx	2529 A	1
173	Sternaspis scutata	2541 A	1
174	Sthenalais tertiaglabra	2529 D	1
175	Streblosoma bairdi	2537 D	1
176	Streblosoma sp. Juv.	2545 A	1
177	Syllidae sp. Indet.	2537 E	1
178	Tenonia priops	2543 C	1
179	Terebellides californica	2545 A	1
180	Thelepus setosus	2545 C	1
181	Thelepus setosus	2541 D	1
182	Travisia forbesii	2545 A	1
183	Trochochaeta multisetosa	2526 C	1
184	Typosyllis harti	2526 C	1

MOLLUSCA

185	Acila castrensis	2529 E	1
186	Adontorhina cyclia	2531 E	1
187	Aeolidacea sp. 1	2543 E	1
188	Aeolidacea sp. 2	2541 C	1
189	Alvania compacta	2543 C	1
190	Astarte elliptica	2545 A	1
191	Astyris gausapata	2529 D	1
192	Axinopsida serricata	2529 D	1
193	Balcis sp. Indet.	2541 B	1
194	Teredinidae sp. Indet.	2537 E	1
195	Galeommatacea sp. Indet.	2545 A	1
196	Boreotrophon sp. Indet.	2545 B	1
197	Cardiomya pectinata	2531 B	1
198	Ceratostoma foliatum	2545 B	1
199	Chaetoderma sp. Indet.	2529 D	1
200	Chlamys hastata	2545 B	1
201	Cingula sp. Indet.	2543 B	1
202	Clinocardium nuttalli	2543 C	1
203	Clinocardium sp. Juv.	2545 A	1
204	Compsomyax subdiaphana	2529 D	1
205	Crepipatella lingulata	2545 B	1
206	Cryptonatica affinis	2543 D	1
207	Cyclocardia ventricosa	2545 A	1
208	Cylichna attonsa	2526 D	1
209	Delectopecten sp. Juv.	2545 C	1
210	Delectopecten vancouverensis	2545 B	1
211	Euspira lewisii	2531 B	1
212	Gastropteron pacificum	2529 D	1
213	Hiatella arctica	2545 A	1

VOUCHER COLLECTION
PSR SITE, ELLIOTT BAY, SEATTLE, WA
For R.F. Weston, Inc.
By Marine Taxonomic Services, Ltd.
March, 1997

Vial #		Station	Count
214	Kurtzia arteaga	2545 C	1
215	Lirobittium sp. Indet.	2546 A	1
216	Lucinoma annulatum	2529 D	1
217	Lyonsia californica	2529 C	1
218	Macoma calcarea	2529 D	1
219	Macoma carlottensis	2529 D	1
220	Macoma elimata	2529 D	1
221	Macoma moesta alaskana	2545 C	1
222	Macoma nasuta	2526 D	1
223	Macoma obliqua	2526 D	1
224	Macoma sp. Juv.	2529 D	1
225	Macoma yoldiformis	2529 D	1
226	Mactridae sp. Juv.	2546 B	1
227	Margarites pupillus	2545 A	1
228	Megacrenella columbiana	2529 D	1
229	Mytilus sp. Juv.	2529 D	1
230	Musculus discors	2545 C	1
231	Musculus sp. Juv.	2537 B	1
232	Mya arenaria	2537 D	1
233	Mysella tumida	2529 D	1
234	Mytilidae sp. Juv.	2529 B	1
235	Nassarius mendicus	2543 E	1
236	Nemocardium centrifilosum	2529 C	1
237	Nucula tenuis	2529 D	1
238	Nuculana sp. Indet.	2545 A	1
239	Odostomia sp. Indet.	2535 D	1
240	Pandora filosa	2529 D	1
241	Parvilucina tenuisculpta	2529 D	1
242	Psephidia lordi	2529 C	1
243	Retusa sp. Indet.	2545 B	1
244	Rictaxis punctocaelatus	2529 C	1
245	Solen sicarius	2543 C	1
246	Tellina sp. Juv.	2531 B	1
247	Thracia trapezoides	2529 D	1
248	Thyasira gouldi	2543 C	1
249	Trichotopis cancellata	2545 B	1
250	Turbonilla sp. Indet.	2529 D	1
251	Vitreolina columbiana	2545 A	1
252	Vitrinella columbiana	2526 D	1
253	Yoldia scissurata	2529 D	1
254	Yoldia sp. Juv.	2535 E	1

CRUSTACEA

255	Ampelisca agassizi	2545C	1
256	Ampelisca brevisimulata	2546A	1
257	Ampelisca careyi	2545A	1
258	Ampelisca hancocki	2526C	1
259	Ampelisca lobata	2545A	2
260	Aoroides intermedia	2543C	3
261	Araphura sp A	2546B	1
262	Byblis millsi	2545A	1
263	Campylaspis hartae	2546E	1
264	Campylaspis rubromaculata	2533B	1
265	Cancer gracilis	2543D	4

VOUCHER COLLECTION
PSR SITE, ELLIOTT BAY, SEATTLE, WA
For R.F. Weston, Inc.
By Marine Taxonomic Services, Ltd.
March, 1997

Vial #		Station	Count
266	Caprella mendax	2526D	1
267	Corophium baconi	2545A	1
268	Corophium insidiosum	2534A	1
269	Crangon alaskensis	2526A	1
270	Cyphocaris challengeri	2545A	2
271	Deflexilodes enigmaticus	2545D	1
272	Desdimelita desdichada	2537E	1
273	Desdimelita transmelita	2541A	1
274	Diastylis paraspinulosa	2529D	1
275	Diastylis "santamariensis"	2529C	1
276	Discorsopagurus schmitti	2541B	1
277	Dyopedos monacanthus	2526E	1
278	Eobrolgus chumashi	2526A	1
279	Eochelidium sp A	2543A	1
280	Ericthonius brasiliensis	2543C	1
281	Ericthonius rubricornis	2545A	1
282	Eudorella pacifica	2526A	3
283	Eudorellopsis longirostris	2529C	1
284	Euphilomedes carcharodonta	2526A	5
285	Euphilomedes producta	2526A	5
286	Eusirus columbianus	2541A	1
287	Eyakia robustus	2545E	1
288	Haliophasma geminatum	2529C	1
289	Heptacarpus brevirostris	2545C	1
290	Heterophoxus conlanae	2526D	1
291	Hippomedon sp A	2526C	1
292	Leptochelia dubia	2526A	1
293	Leptognathia gracilis	2533B	1
294	Leptognathia sp E	2535B	1
295	Leucon sp A	2541A	1
296	Limnoria lignorum	2541B	1
297	Mayerella banksia	2546E	1
298	Melphisana "bola"	2545C	2
299	Mesocrangon munitella	2545C	1
300	Metacaprella anomala	2534C	1
301	Metaphoxus frequens	2546B	2
302	Microjassa litotes	2545A	1
303	Munna fernaldi	2545A	1
304	Munnogonium tillerae	2545A	1
305	Mysidella americana	2541D	1
306	Nebalia "pugettensis"	2533A	1
307	Orchomene decipiens	2546A	1
308	Orchomene pacifica	2533B	1
309	Orchomene pinguis	2546A	1
310	Oregonia gracilis	2545A	1
311	Pachynus barnardi	2546B	1
312	Parametaphoxus quaylei	2537A	2
313	Parasterope barnesi	2526A	1
314	Pardalisca tenuipes	2545A	1
315	Photis brevipes	2543D	1
316	Photis macrotica	2545A	1
317	Pinnixa occidentalis	2545B	1
318	Pinnixa schmitti	2543D	3
319	Pleurogonium californiense	2529D	1

VOUCHER COLLECTION
PSR SITE, ELLIOTT BAY, SEATTLE, WA
For R.F. Weston, Inc.
By Marine Taxonomic Services, Ltd.
March, 1997

Vial #		Station	Count
320	Pleurogonium rubicundum	2533A	1
321	Pleusymtes sp A	2543D	1
322	Prachynella lodo	2535B	1
323	Protomedeia prudens	2546A	3
324	Rutiderma lomae	2526A	1
325	Scoloura phillipsi	2546B	1
326	Solidobalanus hesperius	2526A	2
327	Synchelidium pectinatum	2531B	1
328	Synchelidium rectipalmum	2545B	2
329	Upogebia pugettensis	2546A	1
330	Westwoodilla caecula	2526A	4

MISCELLANEOUS

331	Amphiodia periercta	2537D	1
332	Amphiodia sp. Indet.	2537D	1
333	Amphipholis sp. Indet.	2537D	1
334	Amphipholis squamata	2545C	1
335	Amphiuridae sp. Indet.	2537D	1
336	Aplousobranchia sp. Indet.	2545C	1
337	Arhynchite pugettensis	2531B	1
338	Callipallene pacifica	2545A	1
339	Chiridota sp. Indet.	2545E	1
340	Cucumaria piperata	2545C	2
341	Cucumaria sp. Indet.	2545C	2
342	Dendrochirotida sp. Indet.	2545C	1
343	Dendrochirotida sp. Indet.	2541B	2
344	Golfingia sp. Indet.	2545B	1
345	Leptosynapta clarki	2545C	1
346	Leptosynapta transgressor	2545D	1
347	Nynantheae sp. Indet.	2545C	1
348	Ophiura lutkeni	2541B	1
349	Ophiura sp. Indet.	2526D	1
350	Ophiurida sp. Indet.	2537D	1
351	Pentamera cf. pseudopopulifera	2541B	1
352	Pentamera sp. Indet.	2545C	5
353	Pentamera trachyplaca	2537D	1
354	Pentamera trachyplaca	2543A	1
355	Phoronida sp. Indet.	2526 C	2
356	Solasteridae sp. Indet.	2537E	1
357	Thysanocardia nigra	2546B	2

VOUCHER COLLECTION QA REPORT

98-0092.app

VOUCHER COLLECTION QA REPORT
PSR SITE, ELLIOTT BAY, SEATTLE, WA
For R. F. Weston, Inc.
By Marine Taxonomic Services, Ltd.
March, 1997

POLYCHAETA

ID BY HRJ	STATION	NO.	ID BY ER	NO.	RESULT
Amage anops	2545 A	1	ID confirmed	1	
Ampharete labrops	2534 D	1	ID confirmed	1	
Ampharete nr. crassiseta	2545 D	1	ID confirmed	1	
Amphicteis mucronata	2545 A	1	ID confirmed	1	
Amphitrite edwardsi	2529 E	1	ID confirmed	1	
Anobothrus gracilis	2545 A	1	ID confirmed	1	
Aphelochaeta monilaris	2543 E	1	ID confirmed	1	
Aphelochaeta sp. 2	2534 B	1	Cirratulidae sp. Indet.	1	Global change
Aphrodita japonica	2529 B	1	ID confirmed	1	
Aphrodita sp. Juv.	2546 B	1	ID confirmed	1	
Apistobranchus ornatus	2529 E	1	ID confirmed	1	
Aricidea lopezi	2545 C	1	ID confirmed	1	
Armandia brevis	2526 A	1	ID confirmed	1	
Artacama coniferi	2535 B	1	ID confirmed	1	
Artacamella hancocki	2545 C	1	ID confirmed	1	
Asabellides lineata	2545 A	1	ID confirmed	1	
Aschelocheilus beringianus	2545 A	1	ID confirmed	1	
Asychis sp. Juv.	2531 E	1	Maldaninae sp. Indet.	1	Global change
Autolytinae sp. Indet.	2546 B	2	ID confirmed	2	
Barantolla americana	2529 D	1	ID confirmed	1	
Barantolla sp. Juv.	2529 D	1	ID confirmed	1	
Barantolla sp. Juv.	2529 E	1	ID confirmed	1	
Betapista dekkarae	2541 B	1	ID confirmed	1	
Betapista dekkerae	2545 A	1	ID confirmed	1	
Bispira sp. Indet.	2545 A	2	ID confirmed	2	
Bispira sp. Indet.	2545 C	1	ID confirmed	1	
Boccardiella hamata	2533 C	1	ID confirmed	1	
Capitella capitata 'hyperspecies'	2526 D	2	ID confirmed	2	
Caulleriella pacifica	2545 A	2	ID confirmed	2	
Chaetopterus nr. variopedatus	2545 D	1	ID confirmed	1	
Chaetozone acuta	2537 C	1	ID confirmed	1	
Chaetozone nr. setosa	2534 B	1	ID confirmed	1	
Chaetozone sp. A	2533 E	1	Tharyx sp. Indet.	1	Global change
Chone duneri	2545 C	1	ID confirmed	1	
Chone sp. Indet.	2545 D	1	ID confirmed	1	
Cirratulidae sp. Indet.	2526 B	1	ID confirmed	1	
Cirratulus sp. Juv.	2537 B	2	ID confirmed	2	
'Clymenura' gracilis	2546 B	1	ID confirmed	1	
'Clymenura' gracilis	2533 A	1	ID confirmed	1	
Cossura pygodactylata	2526 B	1	ID confirmed	1	
Cossura sp. Indet.	2526 C	1	ID confirmed	1	
Dipolydora akaina	2545 A	1	ID confirmed	1	
Dipolydora cardalia	2526 A	1	ID confirmed	1	
Dipolydora socialis	2545 B	1	ID confirmed	1	
Dorvillea pseudorubrovittata	2541 C	1	ID confirmed	1	
Dorvillea rudolphi	2545 B	1	ID confirmed	1	
Dorvilleidae sp. Indet.	2529 A	1	ID confirmed	1	
Drilonereis longa	2526 A	1	ID confirmed	1	
Drilonereis sp. 1	2545 D	1	Drilonereis longa	1	Global change
Ehlersia heterochaeta	2545 A	2	ID confirmed	2	
Ehlersia hyperioni	2545 A	1	ID confirmed	1	
Epidiopatra hupferiana monroi	2543 C	1	ID confirmed	1	
Epidiopatra hupferiana monroi	2537 B	1	ID confirmed	1	

VOUCHER COLLECTION QA REPORT
PSR SITE, ELLIOTT BAY, SEATTLE, WA
For R. F. Weston, Inc.
By Marine Taxonomic Services, Ltd.
March, 1997

Errano bicirrata	2545 A	1	ID confirmed	1	
Eteone sp. Indet.	2526 A	1	ID confirmed	1	
Euchone incolor	2534 A	1	ID confirmed	1	
Eulalia californiensis	2541 A	1	ID confirmed	1	
Eulalia californiensis	2545 A	1	ID confirmed	1	
Eulalia sp. 1	2545 B	1	ID confirmed	1	
Eumida sp. 1	2529 A	1	Eulalia nr. levicornuta	1	Global change
Eusyllis habei	2545 B	3	ID confirmed	3	
Eusyllis magnifica	2545 A	1	Pionosyllis uraga	1	Global change
Exogone lourei	2529 E	1	ID confirmed	1	
Galathowenia oculata	2535 D	1	ID confirmed	1	
Gattyana ciliata	2545 A	1	ID confirmed	1	
Gattyana ciliata	2545 B	1	ID confirmed	1	
Gattyana cirrosa	2529 E	2	ID confirmed	2	
Gattyana cirrosa	2545 A	1	ID confirmed	1	
Gattyana cirrosa	2545 E	1	ID confirmed	1	
Gattyana cirrosa	2537 D	1	ID confirmed	1	
Glycera americana	2531 B	1	ID confirmed	1	
Glycera nana	2545 A	1	ID confirmed	1	
Glycinde armigera	2534 B	1	ID confirmed	1	
Harmothoe fragilis	2545 C	1	ID confirmed	1	
Heteromastus filobranchus	2541 A	1	ID confirmed	1	
Idanthyrsus saxicavus	2541 B	1	ID confirmed	1	
Idanthyrsus saxicavus	2541 D	1	ID confirmed	1	
Isocirrus longiceps	2541 D	2	ID confirmed	2	
Isocirrus longiceps	2545 A	1	Euclymeninae sp. Juv.	1	Global change
Lanassa nordenskolki	2546 A	1	ID confirmed	1	
Lanassa venusta	2529 A	1	ID confirmed	1	
Laonice cirrata	2545 A	1	ID confirmed	1	
Leitoscoloplos pugettensis	2526 A	1	ID confirmed	1	
Lepidasthenia berkeleyae	2545 A	1	Lepidasthenia longicirrata	1	Global change
Lepidasthenia berkeleyae	2543 C	1	ID confirmed	1	
Lepidasthenia longicirrata	2529 E	1	ID confirmed	1	
?Lepidonotus sp. Juv.	2545 B	1	Lepidasthenia sp. Juv.	1	Global change
Lepidonotus spiculus	2545 A	1	ID confirmed	1	
Levinsenia gracilis	2526 C	1	ID confirmed	1	
Lumbrineris californiensis	2545 A	1	ID confirmed	1	
Lumbrineris cruzensis	2545 A	2	ID confirmed	2	
Magelona longicornis	2545 A	1	ID confirmed	1	
Malmgreniella bansei	2546 C	1	ID confirmed	1	
Malmgreniella berkeleyorum	2545 D	2	ID confirmed	2	
Malmgreniella berkeleyorum	2545 C	1	ID confirmed	1	
Malmgreniella liei	2535 E	1	ID confirmed	1	
Mediomastus ambiseta	2529 C	1	ID confirmed	1	
Mediomastus californiensis	2526 C	1	ID confirmed	1	
Mediomastus californiensis	2526 E	2	ID confirmed	2	
Megalomma splendida	2545 A	1	ID confirmed	1	
Mesochaetopterus taylori	2541 A	2	ID confirmed	2	
Microphthalmus sp. Indet.	2526 A	4	ID confirmed	4	
Microphthalmus sp. Indet.	2534 B	1	ID confirmed	1	
Monticellina serriseta	2529 D	2	ID confirmed	2	
Monticellina serriseta	2534 A	2	ID confirmed	2	
Monticellina sp. A	2529 E	2	ID confirmed	2	
Myriochele heeri	2534 B	3	ID confirmed	3	
Myxicola infundibulum	2545 A	2	ID confirmed	2	

VOUCHER COLLECTION QA REPORT
PSR SITE, ELLIOTT BAY, SEATTLE, WA
For R. F. Weston, Inc.
By Marine Taxonomic Services, Ltd.
March, 1997

Neosabellaria cementarium	2545 A	1	ID confirmed	1	
Nephtys cornuta	2526 C	1	ID confirmed	1	
Nephtys ferruginea	2529 D	1	ID confirmed	1	
Nereis procera	2543 A	1	ID confirmed	1	
Nicomache personata	2545 A	1	ID confirmed	1	
Notocirrus californiensis	2529 C	1	ID confirmed	1	
Notomastus latericius	2545 A	1	ID confirmed	1	
Notomastus tenuis	2545 A	1	ID confirmed	1	
Notoproctus pacificus	2545 A	1	ID confirmed	1	
Odontosyllis phosphorea	2545 A	1	ID confirmed	1	
Onuphis elegans	2543 E	1	ID confirmed	1	
Onuphis iridescens	2545 A	1	ID confirmed	1	
Ophelina acuminata	2545 A	1	ID confirmed	1	
Owenia fusiformis	2533 D	1	ID confirmed	1	
Paleonotus bellis	2545 A	1	ID confirmed	1	
Parandalia fauveli	2526 C	1	ID confirmed	1	
Paraprionospio pinnata	2545 A	1	ID confirmed	1	
Pectinaria californiensis	2526 C	1	ID confirmed	1	
Pectinaria granulata	2541 A	2	ID confirmed	2	
Pherusa plumosa	2545 A	1	ID confirmed	1	
Pholoe glabra	2533 D	1	ID confirmed	1	
Pholoe sp. Indet.	2529 D	1	ID confirmed	1	
Pholoe sp. Indet.	2531 E	1	ID confirmed	1	
Pholoides asperus	2545 A	2	ID confirmed	2	
Phyllochaetopterus prolifica	2545 A	2	ID confirmed	2	
Phyllodoce groenlandica	2543 E	1	ID confirmed	1	
Phyllodoce hartmanae	2529 E	1	ID confirmed	1	
Phyllodoce mucosa	2541 C	1	Phyllodoce groenlandica	1	Global change
Phylo felix	2535 A	1	ID confirmed	1	
Pilargis maculata	2526 C	1	ID confirmed	1	
Pista bansei	2545 A	1	ID confirmed	1	
Pista brevibranchiata	2545 A	1	ID confirmed	1	
Pista elongata	2545 A	2	ID confirmed	2	
Platynereis bicanaliculata	2529 E	1	ID confirmed	1	
Podarke pugettensis	2541 D	1	ID confirmed	1	
Podarkeopsis glabrus	2535 D	1	ID confirmed	1	
Polycirrus californicus	2534 D	1	ID confirmed	1	
Polycirrus californicus	2535 E	1	ID confirmed	1	
Polydora limicola	2529 E	1	ID confirmed	1	
Praxillella gracilis	2537 A	1	ID confirmed	1	
Praxillella pacifica	2531 E	1	ID confirmed	1	
Praxillella sp. Indet.	2529 A	1	Praxillella pacifica	1	Global change
Prionospio jubata	2526 C	1	ID confirmed	1	
Prionospio lighti	2529 D	1	ID confirmed	1	
Prionospio multibranchiata	2529 A	1	ID confirmed	1	
Procerea cornuta	2529 A	1	ID confirmed	1	
Proclea graffi	2545 A	1	ID confirmed	1	
Protodorvillea gracilis	2537 A	1	ID confirmed	1	
Pseudopotamilla myriops	2537 E	1	ID confirmed	1	
Rhodine bitorquata	2545 A	1	ID confirmed	1	
Scalibregma inflatum	2545 C	1	ID confirmed	1	
Schistocomus hiltoni	2545 A	1	ID confirmed	1	
Scionella japonica	2545 A	1	ID confirmed	1	
Scolelepis texana	2545 B	1	ID confirmed	1	
Scoletoma luti	2526 C	1	ID confirmed	1	

VOUCHER COLLECTION QA REPORT
PSR SITE, ELLIOTT BAY, SEATTLE, WA
For R. F. Weston, Inc.
By Marine Taxonomic Services, Ltd.
March, 1997

Sigambra tentaculata	2541 A	1	ID confirmed	1	
Sphaerodoropsis sphaerulifer	2534 B	2	ID confirmed	2	
Spio cirrifera	2526 C	1	ID confirmed	1	
Spiochaetopterus costarum	2526 C	1	ID confirmed	1	
Spiophanes berkeleyorum	2545 A	1	ID confirmed	1	
Spiophanes bombyx	2529 A	1	ID confirmed	1	
Sternaspis scutata	2541 A	1	ID confirmed	1	
Sthenalais tertiaglabra	2529 D	1	ID confirmed	1	
Streblosoma bairdi	2537 D	1	ID confirmed	1	
Streblosoma sp. Juv.	2545 A	1	ID confirmed	1	
Syllidae sp. Indet.	2537 E	1	ID confirmed	1	
Tenonia priops	2543 C	1	ID confirmed	1	
Terebellides californica	2545 A	1	ID confirmed	1	
Thelepus setosus	2545 C	1	ID confirmed	1	
Thelepus setosus	2541 D	1	ID confirmed	1	
Travisia forbesii	2545 A	1	ID confirmed	1	
Trochochaeta multisetosa	2526 C	1	ID confirmed	1	
Typosyllis harti	2526 C	1	ID confirmed	1	

MOLLUSCA

ID BY SW	STATION	NO.	ID BY AF	NO.	RESULT
Acila castrensis	2529 E	1	ID Confirmed	1	
Adontorhina cyclia	2531 E	1	ID Confirmed	1	
Aeolidacea sp. 1	2543 E	1	ID Confirmed	1	
Aeolidacea sp. 2	2541 C	1	ID Confirmed	1	
Alvania compacta	2543 C	1	ID Confirmed	1	
Astarte elliptica	2545 A	1	Tridonta alaskensis	1	No change/synonomous
Astyris gausapata	2529 D	1	ID Confirmed	1	
Axinopsida serricata	2529 D	1	ID Confirmed	1	
Balcis sp. Indet.	2541 B	1	ID accepted, looks like Polygireulima nutila	1	
Bankia sp. Indet.	2537 E	1	?no pallets present; Teredinidae sp.	1	Teredinidae sp. Indet. globally
Bivalvia sp. 1	2545 A	1	Galeommatacea sp.	1	Galeommatacea sp. Indet. globally
Boreotrophon sp. Indet.	2545 B	1	I think it is a C. foliatum w/ broken outer lip so can't see the tooth; otherwise would be Pteropurpura sp.	1	No change
Cardiomya pectinata	2531 B	1	ID Confirmed	1	
Ceratostoma foliatum	2545 B	1	ID Confirmed	1	
Chaetoderma sp. Indet.	2529 D	1	ID Confirmed	1	
Chlamys hastata	2545 B	1	ID Confirmed	1	
Cingula sp. Indet.	2543 B	1	Barleeia sp. Indet.	1	No change
Clinocardium nuttalli	2543 C	1	ID Confirmed	1	
Clinocardium sp. Juv.	2545 A	1	Cardiidae sp. Juv.	1	Cardiidae sp. Juv. local change only
Compsomyax subdiaphana	2529 D	1	ID Confirmed	1	
Crepipatella lingulata	2545 B	1	ID Confirmed	1	
Cryptonatica affinis	2543 D	1	ID Confirmed	1	
Cyclocardia ventricosa	2545 A	1	ID Confirmed	1	
Cylichna attonsa	2526 D	1	ID Confirmed	1	
Delectopecten sp. Juv.	2545 C	1	ID accepted	1	
Delectopecten vancouverensis	2545 B	1	Delectopecten sp.; can't tell what species it is	1	No change

VOUCHER COLLECTION QA REPORT
PSR SITE, ELLIOTT BAY, SEATTLE, WA
For R. F. Weston, Inc.
By Marine Taxonomic Services, Ltd.
March, 1997

Euspira lewisii	2531 B	1	ID Confirmed	1	
Gastropteron pacificum	2529 D	1	ID Confirmed	1	
Hiatella arctica	2545 A	1	ID Confirmed	1	
Kurtzia arteaga	2545 C	1	ID Confirmed	1	
Lirobittium sp. Indet.	2546 A	1	ID Confirmed	1	
Lucinoma annulatum	2529 D	1	ID Confirmed	1	
Lyonsia californica	2529 C	1	ID Confirmed	1	
Macoma calcarea	2529 D	1	ID accepted, too small to open	1	
Macoma carlottensis	2529 D	1	ID Confirmed	1	
Macoma elimata	2529 D	1	ID Confirmed	1	
Macoma moesta alaskana	2545 C	1	ID Confirmed	1	
Macoma nasuta	2526 D	1	ID Confirmed	1	
Macoma obliqua	2526 D	1	ID Confirmed	1	
Macoma sp. Juv.	2529 D	1	ID Confirmed	1	
Macoma yoldiformis	2529 D	1	ID Confirmed	1	
Mactridae sp. Juv.	2546 B	1	ID accepted, poor specimen	1	
Margarites pupillus	2545 A	1	ID Confirmed	1	
Megacrenella columbiana	2529 D	1	ID Confirmed	1	
Modiolus sp. Juv.	2529 D	1	Mytilus sp. Juv. at this size has hairs	1	Mytilus sp. Juv. globally
Musculus discors	2545 C	1	ID Confirmed	1	
Musculus sp. Juv.	2537 B	1	?, poor specimen, Mytilidae sp. Juv.	1	No change
Mya arenaria	2537 D	1	ID Confirmed	1	
Mysella tumida	2529 D	1	ID Confirmed	1	
Mytilidae sp. Juv.	2529 B	1	ID Confirmed	1	
Nassarius mendicus	2543 E	1	ID Confirmed	1	
Nemocardium centrifilosum	2529 C	1	ID Confirmed	1	
Nucula tenuis	2529 D	1	ID Confirmed	1	
Nuculana cf. cellulita	2545 A	1	Nuculana sp. Indet.;teeth count doesn't match N. cellulita	1	Nuculana sp. Indet. globally
Odostomia sp. Indet.	2535 D	1	ID Confirmed	1	
Pandora filosa	2529 D	1	ID Confirmed	1	
Parvilucina tenuisculpta	2529 D	1	ID Confirmed	1	
Psephidia lordi	2529 C	1	ID Confirmed	1	
Retusa sp. Indet.	2545 B	1	ID Confirmed	1	
Rictaxis punctocaelatus	2529 C	1	ID Confirmed	1	
Solen sicarius	2543 C	1	ID Confirmed	1	
Tellina sp. Juv.	2531 B	1	ID Confirmed-probably juv. T. modesta	1	
Thracia trapezoides	2529 D	1	ID Confirmed	1	
Thyasira gouldi	2543 C	1	ID Confirmed	1	
Trichotopis cancellata	2545 B	1	ID Confirmed	1	
Turbonilla sp. Indet.	2529 D	1	ID Confirmed	1	
Vitreolina columbiana	2545 A	1	Vitreolina sp. Indet.; could be either V. columbiana or V. macra	1	No change
Vitrinella columbiana	2526 D	1	ID Confirmed	1	
Yoldia scissurata	2529 D	1	ID Confirmed	1	
Yoldia sp. Juv.	2535 E	1	ID Confirmed	1	

CRUSTACEA

ID BY DC	STATION	NO.	ID BY TP	NO.	RESULT
Ampelisca agassizi	2545C	1	ID Confirmed	1	
Ampelisca brevisimulata	2546A	1	ID Confirmed	1	
Ampelisca careyi	2545A	1	ID Confirmed	1	
Ampelisca hancocki	2526C	1	ID Confirmed	1	
Ampelisca lobata	2545A	2	ID Confirmed	2	

VOUCHER COLLECTION QA REPORT
PSR SITE, ELLIOTT BAY, SEATTLE, WA
For R. F. Weston, Inc.
By Marine Taxonomic Services, Ltd.
March, 1997

Aoroides intermedia	2543C	3	ID Confirmed	3	
Araphura sp A	2546B	1	ID Confirmed	1	
Byblis millsi	2545A	1	ID Confirmed	1	
Campylaspis hartae	2546E	1	ID Confirmed	1	
Campylaspis rubromaculata	2533B	1	ID Confirmed	1	
Cancer gracilis	2543D	4	ID Confirmed	4	
Caprella mendax	2526D	1	ID Confirmed	1	
Corophium baconi	2545A	1	ID Confirmed	1	
Corophium insidiosum	2534A	1	ID Confirmed	1	
Crangon alaskensis	2526A	1	ID Confirmed	1	
Cyphocaris challengeri	2545A	2	ID Confirmed	2	
Deflexilodes enigmaticus	2545D	1	ID Confirmed	1	
Desdimelita desdichada	2537E	1	ID Confirmed	1	
Desdimelita transmelita	2541A	1	ID Confirmed	1	
Diastylis paraspinulosa	2529D	1	ID Confirmed	1	
Diastylis "santamariensis"	2529C	1	ID Confirmed	1	
Discorsopagurus schmitti	2541B	1	ID Confirmed	1	
Dyopedos monacanthus	2526E	1	ID Confirmed	1	
Eobrolgus chumashi	2526A	1	ID Confirmed	1	
Eochelidium sp A	2543A	1	ID Confirmed	1	
Ericthonius brasiliensis	2543C	1	ID Confirmed	1	
Ericthonius rubricornis	2545A	1	ID Confirmed	1	
Eudorella pacifica	2526A	3	ID Confirmed	3	
Eudorellopsis longirostris	2529C	1	ID Confirmed	1	
Euphilomedes carcharodonta	2526A	5	ID Confirmed	5	
Euphilomedes producta	2526A	5	ID Confirmed	5	
Eusirus columbianus	2541A	1	ID Confirmed	1	
Eyakia robustus	2545E	1	ID Confirmed	1	
Haliophasma geminatum	2529C	1	ID Confirmed	1	
Heptacarpus brevirostris	2545C	1	ID Confirmed	1	
Heterophoxus conlanae	2526D	1	ID Confirmed	1	
Hippomedon sp A	2526C	1	ID Confirmed	1	
Leptochelia dubia	2526A	1	ID Confirmed	1	
Leptognathia gracilis	2533B	1	ID Confirmed	1	
Leptognathia sp E	2535B	1	ID Confirmed	1	
Leucon sp A	2541A	1	ID Confirmed	1	
Limnoria lignorum	2541B	1	ID Confirmed	1	
Mayerella banksia	2546E	1	ID Confirmed	1	
Melphisana "bola"	2545C	2	ID Confirmed	2	
Mesocrangon munitella	2545C	1	ID Confirmed	1	
Metacaprella anomala	2534C	1	ID Confirmed	1	
Metaphoxus frequens	2546B	2	ID Confirmed	2	
Microjassa litotes	2545A	1	ID Confirmed	1	
Munna fernaldi	2545A	1	ID Confirmed	1	
Munnogonium tillerae	2545A	1	ID Confirmed	1	
Mysidella americana	2541D	1	ID Confirmed	1	
Nebalia "pugettensis"	2533A	1	ID Confirmed	1	
Orchomene decipiens	2546A	1	ID Confirmed	1	
Orchomene pacifica	2533B	1	ID Confirmed	1	
Orchomene pinguis	2546A	1	ID Confirmed	1	
Oregonia gracilis	2545A	1	ID Confirmed	1	
Pachynus barnardi	2546B	1	ID Confirmed	1	
Parametaphoxus quaylei	2537A	2	ID Confirmed	2	
Parasterope barnesi	2526A	1	ID Confirmed	1	
Pardalisca tenuipes	2545A	1	ID Confirmed	1	

VOUCHER COLLECTION QA REPORT
PSR SITE, ELLIOTT BAY, SEATTLE, WA
For R. F. Weston, Inc.
By Marine Taxonomic Services, Ltd.
March, 1997

Photis brevipes	2543D	1	ID Confirmed	1	
Photis macrotica	2545A	1	ID Confirmed	1	
Pinnixa occidentalis	2545B	1	ID Confirmed	1	
Pinnixa schmitti	2543D	3	ID Confirmed	3	
Pleurogonium californiense	2529D	1	ID Confirmed	1	
Pleurogonium rubicundum	2533A	1	ID Confirmed	1	
Pleusymtes sp A	2543D	1	ID Confirmed	1	
Prachynella lodo	2535B	1	ID Confirmed	1	
Protomedeia prudens	2546A	3	ID Confirmed	3	
Rutiderma lomae	2526A	1	ID Confirmed	1	
Scoloura phillipsi	2546B	1	ID Confirmed	1	
Solidobalanus hesperius	2526A	2	ID Confirmed	2	
Synchelidium pectinatum	2531B	1	ID Confirmed	1	
Synchelidium rectipalmum	2545B	2	ID Confirmed	2	
Upogebia pugettensis	2546A	1	ID Confirmed	1	
Westwoodilla caecula	2526A	4	ID Confirmed	4	

SORTING QA REPORT

98-0092.app

ELLIOTT BAY PSR SITE, SEATTLE, WA
For R. F. Weston, Inc.
SORTING QA REPORT
By Marine Taxonomic Services, Ltd.
March, 1997

STATION	REP	TOTAL # OF ORG. FOUND	COUNT POLYCHAETA	MOLLUSCA	CRUSTACEA	MISC	SORTER	P=pass
2526	A	1442	1	2	0	0	SW	P
	B	1002	0	0	1	0	SW	P
	C	1045	1	0	0	0	DG	P
	D	1003	0	0	0	0	TI	P
	E	1087	0	0	0	0	SW	P
2529	A	1669	1	3	1	0	SW	P
	B	1892	0	0	0	0	RZ	P
	C	1541	2	1	1	0	CVM	P
	D	2205	1	2	0	0	SJ	P
	E	1565	1	1	2	0	JJ	P
2531	A	1058	0	1	0	0	SW	P
	B	1136	1	0	0	0	JJ	P
	C	862	1	0	0	0	RZ	P
	D	1510	2	2	1	0	JJ	P
	E	1608	1	3	0	0	JJ	P
2533	A	1282	0	0	1	0	HL	P
	B	1756	0	0	0	0	RZ	P
	C	1160	0	0	0	0	SW	P
	D	1721	0	0	0	0	SW	P
	E	1580	1	0	0	0	KJ	P
2534	A	640	0	0	0	0	CVM	P
	B	1197	0	0	0	0	TI	P
	C1	680	0	0	0	0	TI	P
	C2	832	1	0	0	0	TI	P
	D1	741	0	0	0	0	RZ	P
	D2	856	0	1	0	0	RZ	P
	E1	723	1	0	0	0	TI	P
	E2	740	0	1	0	0	TI	P
2535	A	754	1	0	0	0	TI	P
	B1	1589	0	0	1	0	RZ	P
	B2	1046	0	2	0	0	JJ	P
	C	1069	0	3	1	0	TI	P
	D1	932	0	0	0	0	TI	P
	D2	761	0	1	0	0	CVM	P
	E1	1191	0	0	0	0	RZ	P
	E2	720	2	2	0	0	CVM	P
2537	A1	838	0	0	1	0	TI	P
	A2	754	1	0	0	0	CVM	P
	B1	538	0	1	0	0	DG	P
	B2	710	0	0	0	0	CVM	P
	C1	1310	1	0	1	0	RZ	P
	C2	1183	0	0	0	0	RZ	P
	D1	778	0	0	0	0	SW	P
	D2	1178	0	0	0	0	RZ	P

ELLIOTT BAY PSR SITE, SEATTLE, WA
For R. F. Weston, Inc.
SORTING QA REPORT
By Marine Taxonomic Services, Ltd.
March, 1997

STATION	REP	TOTAL # OF ORG. FOUND	COUNT POLYCHAETA	MOLLUSCA	CRUSTACEA	MISC	SORTER	P=pass
	E1	397	0	1	0	0	DG	P
	E2	1154	1	0	1	0	RZ	P
	E3	416	0	0	0	0	TI	P
2541	A1	1486	0	1	0	0	CVM	P
	A2	785	1	0	0	0	KJ	P
	B1	761	1	0	0	0	KJ	P
	B2	636	0	0	0	0	JJ	P
	B3	667	0	0	1	0	RZ	P
	C1	935	1	0	0	0	SW	P
	C2	919	0	0	1	0	SW	P
	D1	731	0	0	0	0	RZ	P
	D2	459	2	0	0	0	CVM	P
	D3	546	1	0	1	0	DG	P
	E1	455	0	0	0	0	DG	P
	E2	465	0	0	0	0	CVM	P
	E3	416	1	0	1	0	TI	P
2543	A	879	3	0	1	0	CVM	P
	B	861	1	0	2	1	TI	P
	C	940	0	1	1	0	CVM	P
	D	811	0	0	1	0	TI	P
	E	777	0	4	0	0	CVM	P
2545	A	1167	0	0	0	0	RZ	P
	B	1242	0	0	0	0	RZ	P
	C	805	0	1	0	0	RZ	P
	D	903	0	0	0	0	DG	P
	E	787	1	0	0	0	DG	P
2546	A	742	0	0	0	0	TI	P
	B	951	0	0	0	0	RZ	P
	C	912	0	0	0	0	RZ	P
	D	870	1	2	0	0	JJ	P
	E	955	0	1	1	1	JJ	P

BULK SAMPLE QA REPORT

BULK SAMPLE QA REPORT
For R. F. Weston, Inc.
By Marine Taxonomic Services, Ltd.
March, 1997

Station 2534 B
POLYCHAETES

ID BY HRJ	COUNT	ID BY RER	COUNT	RESULT
Ampharete sp. Indet.	1	Ampharete finmarchica	1	
Aphelochaeta sp. 2	3	Cirratulidae sp. Indet.	3	Cirratulidae sp. Indet.
Aphelochaeta sp. N-1	2		2	
Apistobranchus ornatus	3		3	
Aricidea lopezi	3		2	
Asabellides lineata	1		1	
Chaetoderma sp. Indet. (mollusc)	2		2	
Chaetozone nr. setosa	2		2	
Dipolydora caulleryi	2		2	
Glycera nana	7		7	
Glycinde armigera	2		2	
Leitoscoloplos pugettensis	1		1	
Levinsenia gracilis	5		5	
Lumbrineridae sp. Juv.	1			
Maldanidae sp. Indet.	2		2	
Mediomastus sp. Indet.	4		4	
Megalomma splendida	1		1	
Microphthalmus sp. Indet.	2		2	
Myriochele heeri	6		3	
Nemertinea	4		4	
Nephtys cornuta	11		10	
Nephtys ferruginea	1		1	
Notomastus tenuis	2		2	
Onuphidae sp. Juv.	2		2	
Onuphis iridescens	2		2	
Ophelina acuminata	1		1	
Paraprionospio pinnata	11		10	
Pectianria californiensis	56		50	
Pholoe minuta	1	(partially dried)	1	
Pilargis maculata	4		4	
Polycirrus californiensis	2		1	
Prionospio jubata	13		15	
Scoletoma luti	8		9	
Sigambra sp. Juv.	1		1	
Sphaerodoropsis sphaerulifer	8		8	
Spiochaetopterus costarum	2		2	
Syllis harti	3	Typosyllis harti	3	Typosyllis harti
Tenonia priops	2		2	
Terebellidae sp. Indet.	9		9	
Terebellides californica	1		1	
Trochochaeta multisetosa	6		6	
		Chaetozone sp. Indet. (anterior frag)	1	

BULK SAMPLE QA REPORT
For R. F. Weston, Inc.
By Marine Taxonomic Services, Ltd.
March, 1997

Station 2543 A
POLYCHAETES

ID BY HRJ	COUNT	ID BY RER	COUNT	RESULT
Anobothrus gracilis	3		3	
Aphelochaeta monilaris	1		2	
Aphelochaeta sp. N-1	6		6	
Caulleriella pacifica	1		1	
Chaetozone sp. 1	1			
Cirratulidae sp. Indet.	2		1	
Diopatra ornata	1		1	
Dipolydora cardalia	1		1	
Dipolydora caulleryi	1		1	
Ehlersia hyperioni	3		3	
Eteone sp. Indet.	2		2	
Euchone ?hancocki	2	Euchone incolor	2	Euchone incolor
Eumida longicornuta	4		4	
Exogone lourei	1		1	
Glycera nana	3		3	
Heteromastus filobranchus	2		2	
Levinsenia gracilis	2		2	
Lumbrineridae sp. Indet.	7		6	
Lumbrineris californiensis	26		28	
Medioamstus sp. Indet.	10		12	
Mesochaetopterus taylori	1		1	
Nemertinea	5		4	
Nephtys cornuta	4		3	
Nephtys feruginea	5		5	
Nereis procera	1		1	
Notomastus tenuis	18		15	
Paraprionospio pinnata	7		8	
Pectinaria californiensis	9		9	
Pectinaria granulata	1		1	
Pholoides aspera	3		3	
Phyllodoce groenlandica	2		2	
Phyllodoce williamsi	1	Phyllodoce groenlandica	1	Phyllodoce groenlandica
Pilargis maculata	1		1	
Podarkeopsis glabrus	1		1	
Prionospio jubata	47		43	
Prionospio lighti	2		2	
Proclea graffi	1		1	
Scoletoma luti	4		4	
Sphaerodoropsis sphaerulifer	1		1	
Spiochaetopterus costarum	23		23	
Syllis harti	5	Typosyllis harti	5	Typosyllis harti
Tenonia priops	1		1	
		Aricidea lopezi	1	Aricidea lopezi
		Monticellina serriseta	1	Monticellina serriseta

BULK SAMPLE QA REPORT
For R. F. Weston, Inc.
By Marine Taxonomic Services, Ltd.
March, 1997

Station 2546 A
POLYCHAETES

ID BY HRJ	COUNT	ID BY RER	COUNT	RESULT
Aphelochaeta monilaris	3		3	
Apistobranchus ornatus	1		1	
Aricidea lopezi	4		4	
Brada villosa	1		1	
Chaetozone nr. setosa	8		8	
Cirratulidae sp. Indet.	3		2	
Clymenura columbiana	1			
'Clymenura' gracilis	7		6	
Eteone sp. Indet.	1		1	
Eumida longicornuta	1		1	
Exogone molesta	1	Exogone lourei	1	Exogone lourei
Glycera americana	1			
Glycera nana	5		6	
Glycinde armigera	2		2	
Golfingia sp. Indet.	2		2	
Lanassa nordenskoldi	21		23	
Leitoscoloplos pugettensis	10		10	
Lumbrineridae sp. Indet.	4		6	
Magelona longicornis	2		2	
Maldanidae sp. Indet.	1		4	
Maldanidae sp. Indet.	1			
Mediomastus sp. Indet.	2		2	
Megalomma splendida	2		2	
Metasychis disparadentata	1		1	
Myriochele heeri	13		12	
Myxicola infundibula	1			
Nemertinea	3		2	
Nephtys cornuta	1		1	
Nephtys ferruginea	1		1	
Nephtys sp. Juv.	1		1	
Notomastus tenuis	4		4	
Onuphidae sp. Juv.	17		17	
Onuphis iridescens	2		2	
Paraprionospio pinnata	7		7	
Pectinaria californiensis	82		79	
Pholoe minuta	1		1	
Phoronida sp. Indet.	1		1	
Phyllodoce groenlandica	2		2	
Phyllodoce hartmanae	1		1	
Phylo felix	1		1	
Pilargis maculata	1		1	
Polycirrus californiensis	4		6	
Prionospio jubata	22		21	
Proclea graffi	2			
Rhodine bitorquata	1		1	
Sabellidae sp. Indet.	1		1	
Scionella japonica	2			
Scoletoma luti	4		2	
Sphaerodoropsis sphaerulifer	1		1	
Sthenalais tertiaglabra	2		2	
Tenonia priops	1		1	

Terebellidae sp. Juv.	3		2	
Terebellides californica	1		1	
Trochochaeta multisetosa	4		4	
		Pectinaria granulata	1	Pectinaria granulata
		Prionospio lighti	1	Prionospio lighti

BULK SAMPLE QA REPORT
For R. F. Weston, Inc.
By Marine Taxonomic Services, Ltd.
March, 1997

Station 2546 A
MOLLUSCS

ID BY SW	COUNT	ID BY AF	COUNT	RESULT
Adontorhina cyclia	2			
Alvania compacta	1		1	
Astyris gausapata	1		1	
Axinopsida serricata	81	Plus one dead shell	82	
Cardiomhya pectinata	1		1	
Compsomyax subdiaphana	2		2	
Lirobittium sp. Indet.	6	Lirobittium cf. attenuatum	5	Lirobittium sp. Indet.
Lucinoma annulatum	6		6	
Lyonsia californica	6		4	
Macoma carlottensis	20			
Macoma sp. Juv.	54	Probably M. carlottensis	71	Macoma sp. Juv.
Macoma yoldiformis	4		4	
Megacrenella columbiana	9		9	
Mysella tumida	2		2	
Nemocardium centrifilosum	7		7	
Nucula tenuis	2		2	
Nuculana minuta	4		4	
Pandora filosa	4		6	
Parvilucina tenuisculpta	29		29	
Turbonilla sp. Indet.	1		1	
Yoldia scissurata	5		3	
		Yoldia sp. Juv.	2	Yoldia scissurata

BULK SAMPLE QA REPORT
For R. F. Weston, Inc.
By Marine Taxonomic Services, Ltd.
March, 1997

Station 2543 A
MOLLUSCS

ID BY SW	COUNT	ID BY AF	COUNT	RESULT
Astyris gausapata	3		3	
Axinopsida serricata	211	Plus one dead shell	205	
Chaetoderma sp. Indet.	1		1	
Compsomyax subdiaphana	2		2	
Lucinoma annulatum	7		7	
Lyonsia californica	2		2	
Macoma calcarea	1			
Macoma carlottensis	25		26	
Macoma elimata	1			
Macoma obliqua	1		2	
Macoma sp. Juv.	12	Probably M. carlottensis	14	Macoma sp. Juv.
Macoma yoldiformis	6		4	
Megacrenella columbiana	2		2	
Nemocardium centrifilosum	1		1	
Nucula tenuis	2		2	
Pandora filosa	1		1	
Parvilucina tenuisculpta	89		91	
Psephidia lordi	2		2	

BULK SAMPLE QA REPORT
For R. F. Weston, Inc.
By Marine Taxonomic Services, Ltd.
March, 1997

Station 2533 D
MOLLUSCS

ID BY SW	COUNT	ID BY AF	COUNT	RESULT
Acila castrensis	1			
Alvania compacta	6		6	
Astyris gausapata	5		5	
Axinopsida serricata	272		274	
Chaetoderma sp. Indet.	2		2	
Compsomyax subdiaphana	7		6	
Gastropoda sp. Juv.	2	Gastropoda sp. Indet.	1	Gastropoda sp. Juv.
Hiatella arctica	1		1	
Lucinoma annulatum	7		6	
Lyonsia californica	7		7	
Macoma carlottensis	152		167	
Macoma elimata	3		3	
Macoma sp. Juv.	173		131	
Macoma yoldiformis	6		8	
Megacrenella columbiana	14		14	
Nemocardium centrifilosum	11		11	
Nucula tenuis	12		13	
Nuculana minuta	9		9	
Parvilucina tenuisculpta	21		22	
Psephidia lordi	1		1	
Turbonilla sp. Indet.	3		2	

BULK SAMPLE QA REPORT
For R. F. Weston, Inc.
By Marine Taxonomic Services, Ltd.
March, 1997

Station 2533 D
CRUSTACEA

ID by DC	COUNT	ID BY TP	COUNT	RESULT
Eudorella pacifica	14	ID OK	14	
Eudorellopsis longirostris	2	ID OK	2	
Euphilomedes carcharodonta	176	ID OK	177	176
Euphilomedes producta	174	ID OK	173	174
Haliophasm geminatum	1	ID OK	1	
Hippomedon sp. A	1	ID OK	1	
Neotrypaea sp.	1	ID OK	1	
Orchomene pacifica	1	ID OK	1	
Parasterope barnesi	2	ID OK	2	
Rutiderma lomae	22	ID OK	22	
Scoloura phillipsi	2	ID OK	2	
Westwoodilla caecula	1	ID OK	1	

BULK SAMPLE QA REPORT
For R. F. Weston, Inc.
By Marine Taxonomic Services, Ltd.
March, 1997

Station 2541 A
CRUSTACEA

ID by DC	COUNT	ID BY TP	COUNT	RESULT
Aoroides intermedia	1	Aoroides sp.	1	A. intermedia
Byblis millsi	3	ID OK	3	
Corophium insidiosum	1	ID OK	1	
Crangon alaskensis	2	ID OK	2	
Cyclopoida	1	ID OK	1	
Diastylis "santamariensis"	1	ID OK	1	
Diastylis paraspinulosa	3	ID OK	3	
Eudorella pacifica	16	ID OK	16	
Eudorellopsis longirostris	1	ID OK	1	
Euphilomedes carcharodonta	165	ID OK	165	
Euphilomedes producta	145	ID OK	146	145
Euphilomedes sp.	1			1
Haliophasma geminatum	2	ID OK	2	
Heterophoxus conlanae	2	ID OK	2	
Heterophoxus sp.	1	ID OK	1	
Mayerella banksia	1	ID OK	1	
Metaphoxus frequens	2	Parametaphoxus quaylei	2	1 of each
Natantia	3			
		Hippolytidae	2	Hyppolytidae
		Mysidae	1	Mysidae
Orchomene pacifica	1	Orchomene decipiens	1	O. pacifica
Parasterope barnesi	1	ID OK	1	
Pinnotheridae	1	ID OK	1	
Prachynella lodo	1	ID OK	1	
Rutiderma lomae	14	ID OK	14	
Synchelidium pectinatum	1	Synchelidium variabilum	1	S. rectipalmum
Upogebia pugettensis	4	ID OK	4	
Westwoodilla caecula	2	ID OK	2	
		Desdimelita sp.	1	moult, not recorded

BULK SAMPLE QA REPORT
For R. F. Weston, Inc.
By Marine Taxonomic Services, Ltd.
March, 1997

Station 2543 B
CRUSTACEA

ID by DC	COUNT	ID BY TP	COUNT	RESULT
Aoroides intermedia	2	Aroides sp.	2	A. intermedia
Dypoedos monacanthus	2	ID OK	2	
Ericthonius brasiliensis	2	ID OK	2	
Eudorella pacifica	1	ID OK	1	
Euphilomedes carcharodonta	90	ID OK	91	90
Euphilomedes producta	10	ID OK	10	
Haliophasma geminatum	1	ID OK	1	
Nebalia "pugettensis"	1	ID OK	1	
Neotrypaea sp.	1	ID OK	1	
Pinnixa schmitti	1	ID OK	1	
Pinnixa sp.	9	ID OK	10	10
Westwoodilla caecula	2	ID OK	2	

BENTHIC REPLICATE DATA

TAXON	2526-A	2526-B	2526-C	2526-D	2526-E	SppCount
			EB49			
POLYCHAETA						
Amage anops						
Ampharete finmarchica						
Ampharete labrops	1					**1**
Ampharete nr. crassiseta		2				**2**
Ampharete sp. Indet./Juv.						
Ampharetidae sp. Indet./Juv.			1			**1**
Amphicteis mucronata						
Amphitrite edwardsi						
Amphitrite robusta						
Anobothrus gracilis	1	1		1	1	**4**
Aphelochaeta monilaris	5	1	1	4	2	**13**
Aphelochaeta sp. 2						
Aphelochaeta sp. Indet.		5	8	7		**20**
Aphelochaeta sp. N-1	4		1			**5**
Aphrodita japonica						
Aphrodita sp. Juv.						
Apistobranchus ornatus	8	2	3	1	1	**15**
Aricidea lopezi	1		1		1	**3**
Aricidea ramosa						
Armandia brevis	1					**1**
Artacama coniferi						
Artacamella hancocki						
Asabellides lineata		2	1	1		**4**
Asclerocheilus beringianus						
Autolytinae sp. Indet.						
Barantolla americana	4	2		3	8	**17**
Barantolla sp. Juv.						
Betapista dekkerae						
Bispira sp. Indet.						
Boccardiella hamata						
Capitella capitata 'hyperspecies'	1	1	1	7	1	**11**
Capitellidae sp. Indet./Juv.		1				**1**
Caulleriella pacifica					1	**1**
Chaetopteridae sp. Indet.						
Chaetopterus nr. variopedatus					1	**1**
Chaetozone acuta						
Chaetozone nr. setosa	12	6	9	12	4	**43**
Chaetozone sp. Indet.						
Chone duneri						
Chone sp. Indet.						
Cirratulidae sp. Indet./Juv.	14	1	3		2	**20**
Cirratulus sp. Juv.						
Cirratulus spectabilis		1				**1**
'Clymenura' gracilis				1		**1**
Cossura pygodactylata		1				**1**
Cossura sp. Indet./Juv.	5	2	1	3		**11**
Diopatra ornata	1	2		1		**4**
Dipolydora akaina		3			1	**4**
Dipolydora cardalia	1		1	1	1	**4**
Dipolydora socialis						
Dorvillea pseudorubrovittata						

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB49

			EB49			
TAXON	2526-A	2526-B	2526-C	2526-D	2526-E	SppCount
Dorvillea rudolphi						
Dorvillea sp. Indet.						
Dorvilleidae sp. Indet.						
Drilonereis falcata						
Drilonereis longa	2					2
Ehlersia heterochaeta	1	1		2		4
Ehlersia hyperioni						
Epidiopatra hypferiona monroi						
Errano bicirrata						
Eteone sp. Indet.	1			1	1	3
Euchone incolor		1		1		2
Euclymeninae sp. Indet./Juv.	1					1
Eulalia californiensis			1	1		2
Eulalia nr. levicornuta						
Eulalia sp. 1						
Eumida longicornuta	6	5		1	3	15
Eusyllis habei						
Exogone lourei	2	6		1	4	13
Exogone molesta	4	1				5
Galathowenia oculata						
Gattyana ciliata						
Gattyana cirrosa						
Glycera americana						
Glycera nana	14	5	4	10	9	42
Glycinde armigera	4	1	3	2	3	13
Glycinde polygnatha						
Goniada maculata						
Harmothoe fragilis						
Harmothoe imbricata						
Hesionidae sp. Indet./Juv.			1			1
Heteromastus filobranchus	5	5	12	7	8	37
Idanthyrsus saxicavus						
Isocirrus longiceps						
Lanassa nordenskioldi			1	1		2
Lanassa sp. Indet.					1	1
Lanassa venusta						
Laonice cirrata		1				1
Leitoscoloplos pugettensis	1		1		2	4
Lepidasthenia berkeleyae						
Lepidasthenia longicirrata						
Lepidasthenia sp. Indet./Juv.						
Lepidonotus spiculus						
Levinsenia gracilis	3	3	1	3	4	14
Lumbrineridae sp. Indet./Juv.	19	9	14	11	8	61
Lumbrineris californiensis	4	4	6		1	15
Lumbrineris cruzensis						
Lumbrineris limicola						
Lumbrineris sp. Indet.						
Magelona longicornis	30	19	6	8	9	72
Magelona sp. Juv.	1					1
Maldane sarsi						
Maldanidae sp. Indet./Juv.			1			1

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB49

	EB49					
TAXON	2526-A	2526-B	2526-C	2526-D	2526-E	SppCount
Maldaninae sp. Indet.						
Malmgreniella bansei						
Malmgreniella berkeleyorum						
Malmgreniella liei						
Malmgreniella sp. Juv.						
Mediomastus ambiseta						
Mediomastus californiensis			2		2	**4**
Mediomastus sp. Indet.	11	9	8	11	13	**52**
Megalomma splendida	1					**1**
Mesochaetopterus taylori	1		1			**2**
Metascyhis disparadentata						
Microphthalmus sp. Indet.	4	2			2	**8**
Micropodarke dubia						
Monticellina serratiseta			1			**1**
Monticellina sp. A		1				**1**
Monticellina sp. Indet.			2			**2**
Myriochele heeri	1					**1**
Myxicola infundibulum						
Neosabellaria cementarium						
Nephtys cornuta	1	2	9	6	2	**20**
Nephtys ferruginea	1	2	4	3	5	**15**
Nephtys sp. Indet./Juv.	1					**1**
Nereis procera						
Nereis sp. Juv.						
Nereis zonata						
Nicomache personata						
Notocirrus californiensis						
Notomastus latericius						
Notomastus tenuis	6	7	7	7	1	**28**
Notoproctus pacificus						
Odontosyllis phosphorea						
Oligochaeta sp. Indet.	1					**1**
Onuphidae sp. Indet./Juv.	1				1	**2**
Onuphis elegans						
Onuphis iridescens	1	1				**2**
Onuphis sp. Juv.						
Ophelina acuminata						
Owenia fusiformis						
Paleonotus bellis						
Parandalia fauveli	1	5	4	2	4	**16**
Paraprionospio pinnata	14	9	14	12	17	**66**
Parougia caeca						
Pectianria californiensis	5	4	2	2	3	**16**
Pectinaria granulata	1			1	4	**6**
Pectinaria sp. Juv.						
Pherusa plumosa						
Pholoe glabra	1				1	**2**
Pholoe sp. Indet.						
Pholoides asperus						
Phyllochaetopterus prolifica						
Phyllodoce groenlandica	1				1	**2**
Phyllodoce hartmanae		1	2	1	1	**5**

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB49

	EB49					
TAXON	2526-A	2526-B	2526-C	2526-D	2526-E	SppCount
Phyllodoce sp. Juv.		1				1
Phyllodoce williamsi		1		1		2
Phylo felix	1					1
Pilargis maculata	2		5	2	2	11
Pionosyllis uraga						
Pista bansei						
Pista brevibranchiata						
Pista elongata						
Pista sp. Juv.						
Platynereis bicanaliculata						
Podarke pugettensis						
Podarkeopsis glabrus	1			1	2	4
Polycirrus californicus		1	1			2
Polycirrus sp. complex						
Polydora caulleryi						
Polydora limicola	1	1				2
Polydora sp. Indet./Juv.						
Polynoidae sp. Indet.						
Praxillella gracilis						
Praxillella pacifica						
Praxillella sp. Indet.						
Prionospio jubata	34	15	19	21	13	102
Prionospio lighti	8	1	1	1	2	13
Prionospio multibranchiata						
Prionospio sp. Indet.						
Procerea cornuta						
Proclea graffi					1	1
Protodorvillea gracilis						
Pseudopotamilla myriops						
Pseudopotamilla neglecta						
Rhodine bitorquata	1					1
Sabellidae sp. Indet.						
Scalibregma inflatum						
Schistocomus hiltoni						
Scionella japonica						
Scolelepis texana						
Scoletoma luti	25	22	22	21	24	114
Sigambra sp. Juv.						
Sigambra tentaculata						
Sphaerodoropsis sphaerulifer		2	1	4		7
Sphaerosyllis ranunculus						
Spio cirrifera			1			1
Spiochaetopterus costarum	89	69	13	35	27	233
Spionidae sp. Indet./Juv.	1					1
Spiophanes berkeleyorum	2	3	2	1		8
Spiophanes bombyx						
Sternaspis scutata						
Sthenalais tertiaglabra	2	1	1			4
Streblosoma bairdi						
Streblosoma sp. Juv.						
Syllidae sp. Indet./Juv.						
Tenonia priops						

	EB49					
TAXON	2526-A	2526-B	2526-C	2526-D	2526-E	SppCount
Terebellidae sp. Indet./Juv.						
Terebellides californica						
Tharyx sp. Indet.						
Thelepus setosus						
Travisia forbesii						
Travisia sp. Juv.						
Trochochaeta multisetosa	1	2	1	1	3	**8**
Typosyllis harti	7	1	3	2	2	**15**

REPLICATE TPOLYAB	**385**	**257**	**208**	**226**	**210**
REPLICATE TPOLYRC	**62**	**53**	**48**	**45**	**47**
STATION TPOLYAB	**1286**				
STATION TPOLYRC	**91**				

MOLLUSCA

Acila castrensis						
Adontorhina cyclia						
Aeolidacea sp. 1						
Aeolidacea sp. 2						
Alvania compacta	4	11			1	**16**
Astarte elliptica						
Astyris gausapata	3	9	7	2	19	**40**
Axinopsida serricata	181	162	269	242	166	**1020**
Balcis sp. Indet.						
Barleeia sp. Indet.						
Bivalvia sp. Juv.						
Boreotrophon sp. Indet.						
Cardiidae sp. Juv.		1				**1**
Cardiomya pectinata						
Ceratostoma foliatum						
Chaetoderma sp. Indet.						
Chlamys hastata						
Cingula sp. Indet.						
Clinocardium nuttalli	1				1	**2**
Clinocardium sp. Juv.					1	**1**
Compsomyax subdiaphana	1		2	2		**5**
Crepipatella lingulata						
Cryptonatica affinis						
Cyclocardia ventricosa						
Cylichna attonsa				2	1	**3**
Delectopecten sp. Juv.						
Delectopecten vancouverensis						
Euspira lewisii						
Galeommatacea sp. Indet.						
Gastropoda sp. Juv.						
Gastropteron pacificum						
Hiatella arctica						
Kurtzia arteaga						
Lirobittium sp. Indet.						
Lucinoma annulatum	1		3	2	8	**14**
Lyonsia californica	3	3	1	1	2	**10**
Macoma calcarea						

	EB49					
TAXON	2526-A	2526-B	2526-C	2526-D	2526-E	SppCount
Macoma carlottensis	41	50	58	35	47	231
Macoma elimata	4			1	1	6
Macoma moesta alaskana						
Macoma nasuta		1	1	1	2	5
Macoma obliqua		1		2		3
Macoma sp. Juv.	19	23	4	9	11	66
Macoma yoldiformis	48	22	62	48	80	260
Mactridae sp. Juv.						
Margarites pupillus						
Megacrenella columbiana	2	2	1	1	2	8
Musculus discors						
Musculus sp. Juv.						
Mya arenaria						
Mysella tumida	4	4	8	9	4	29
Mytilidae sp. Juv.				1		1
Mytilus sp. Juv.						
Nassarius mendicus						
Nemocardium centrifilosum			1		1	2
Nucula tenuis	3	2	9	5	13	32
Nuculana minuta						
Nuculana sp. Indet.						
Nudibranchia sp. Indet.						
Odostomia sp. Indet.	1	3			1	5
Pandora filosa	1		3	1		5
Pandora sp. Juv.						
Parvilucina tenuisculpta	86	89	186	188	130	679
Psephidia lordi	21	14	25	10	21	91
Retusa sp. Indet.						
Rictaxis punctocaelatus						
Solen sicarius			1		1	2
Tellina sp. Juv.	1		1		1	3
Teredinidae sp. Indet.						
Thracia trapezoides						
Thyasira gouldi		1	2		1	4
Trichotopis cancellata						
Turbonilla sp. Indet.						
Vitreolina columbiana						
Vitrinella columbiana		7		1	1	9
Yoldia scissurata						
Yoldia sp. Juv.						

REPLICATE TMOLLAB	**425**	**405**	**644**	**563**	**516**
REPLICATE TMOLLRC	**19**	**18**	**19**	**20**	**24**
STATION TMOLLAB	**2553**				
STATION TMOLLRC	**29**				

CRUSTACEA

Ampelisca agassizi						
Ampelisca brevisimulata						
Ampelisca careyi						
Ampelisca hancocki			1			1
Ampelisca lobata						

	EB49					
TAXON	2526-A	2526-B	2526-C	2526-D	2526-E	**SppCount**
Aoroides intermedia						
Aoroides sp						
Araphura sp A						
Balanomorpha						
Byblis millsi						
Campylaspis hartae						
Campylaspis rubromaculata						
Cancer gracilis	1	1	1	1		**4**
Cancer sp						
Caprella mendax				1		**1**
Corophium baconi						
Corophium insidiosum						
Crangon alaskensis	1					**1**
Crangon sp						
Cyclopoida						
Cyphocaris challengeri						
Deflexilodes enigmaticus						
Desdimelita desdichada						
Desdimelita transmelita						
Diastylis paraspinulosa						
Diastylis "santamariensis"				1		**1**
Discorsopagurus schmitti						
Dyopedos monacanthus					1	**1**
Eobrolgus chumashi	1			1		**2**
Eochelidium sp A						
Ericthonius brasiliensis						
Ericthonius rubricornis						
Eualus sp						
Eudorella pacifica	3	4	6	5	2	**20**
Eudorellopsis longirostris						
Euphilomedes carcharodonta	124	96	126	52	88	**486**
Euphilomedes producta	15	4	9	2	5	**35**
Euphilomedes sp						
Eusirus columbianus						
Eyakia robustus						
Haliophasma geminatum						
Heptacarpus brevirostris						
Heterophoxus conlanae				1		**1**
Heterophoxus sp						
Hippolytidae						
Hippomedon sp A			1			**1**
Leptochelia dubia	1	2	1	2		**6**
Leptognathia gracilis						
Leptognathia sp E						
Leucon sp A						
Limnoria lignorum						
Lophopanopeus sp						
Majidae						
Mayerella banksia						
Melphisana "bola"						
Mesocrangon munitella						
Metacaprella anomala						

	EB49					
TAXON	2526-A	2526-B	2526-C	2526-D	2526-E	SppCount
Metaphoxus frequens						
Microjassa litotes						
Munna fernaldi						
Munnogonium tillerae						
Mysidae						
Mysidella americana						
Nebalia "pugettensis"						
Neotrypaea sp	7			1	1	9
Orchomene decipiens						
Orchomene pacifica						
Orchomene pinguis						
Oregonia gracilis						
Pachynus barnardi						
Pagurus sp						
Parametaphoxus quaylei						
Parasterope barnesi	1			1		2
Pardalisca tenuipes						
Photis brevipes						
Photis macrotica						
Photis sp						
Pinnixa occidentalis						
Pinnixa schmitti						
Pinnixa sp	13	5	7	3	5	33
Pinnotheridae						
Pleurogonium californiense						
Pleurogonium rubicundum						
Pleusymtes sp A						
Prachynella lodo						
Protomedeia prudens						
Protomedeia sp						
Rutiderma lomae	1					1
Scoloura phillipsi						
Solidobalanus hesperius	2	1			2	5
Spirontocaris sp						
Synchelidium pectinatum						
Synchelidium rectipalmum						
Synchelidium sp						
Upogebia pugettensis						
Westwoodilla caecula	4	3	2			9

REPLICATE TCRSTAB	**174**	**116**	**154**	**71**	**104**
REPLICATE TCRSTRC	**13**	**8**	**9**	**12**	**7**
STATION TCRSTAB	**619**				
STATION TCRSTRC	**19**				

MISCELLANEOUS

Amphiodia periercta	2	1	6			9
Amphiodia sp. Indet.	10	2	3	1	1	17
Amphipholis sp. Indet.						
Amphipholis squamata						
Amphiuridae sp. Indet.						
Anthozoa sp. Indet.						

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB49

	EB49					
TAXON	2526-A	2526-B	2526-C	2526-D	2526-E	SppCount
Arhynchite pugettensis	2	2	2			**6**
Asteroidea sp. Juv.						
Brachiopoda sp. Indet.						
Chiridota sp. Indet.						
Cucumaria piperata						
Cucumaria sp. Indet.	1					**1**
Dendrochirotida sp. Indet.						
Golfingia sp. Indet.						
Hirudinea sp. Indet.						
Leptosynapta clarki						
Leptosynapta transgressor						
Nemertinea sp. Indet.	3	8	9	3	7	**30**
Nynantheae sp. Indet.						
Ophiura lutkeni	1					**1**
Ophiura sp. Indet.				1		**1**
Ophiurida sp. Indet.	11	5	2	2	7	**27**
Pachycerianthus fimbriata						
Pentamera cf. pseudopopulifera					1	**1**
Pentamera sp. Indet.	1	1	1		1	**4**
Pentamera trachyplaca		2			1	**3**
Phoronida sp. Indet.	1		2			**3**
Phoronis sp. Indet.						
Platyhelminthes sp. Indet.						
Sipunculida sp. Indet.	4	6	10	1	9	**30**
Solasteridae sp. Indet.						
Thysanocardia nigra						
Turbellaria sp. Indet.						

REPLICATE TMISCAB	**36**	**27**	**35**	**8**	**27**
REPLICATE TMISCRC	**10**	**8**	**8**	**5**	**7**
STATION TMISCAB	**133**				
STATION TMISCRC	**13**				
REPLICATE TABUND	**1020**	**805**	**1041**	**868**	**857**
REPLICATE TRICH	**104**	**87**	**84**	**82**	**85**
STATION TABUND	**4591**				
STATION TRICH	**152**				

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB60

TAXON	2529-A	2529-B	2529-C	2529-D	2529-E	SppCount
			EB60			
POLYCHAETA						
Amage anops						
Ampharete finmarchica						
Ampharete labrops						
Ampharete nr. crassiseta						
Ampharete sp. Indet./Juv.						
Ampharetidae sp. Indet./Juv.						
Amphicteis mucronata						
Amphitrite edwardsi					1	1
Amphitrite robusta						
Anobothrus gracilis	4	3	1	1	1	10
Aphelochaeta monilaris	4	3		5	5	17
Aphelochaeta sp. 2						
Aphelochaeta sp. Indet.					2	2
Aphelochaeta sp. N-1	3	2	2	3		10
Aphrodita japonica		1				1
Aphrodita sp. Juv.						
Apistobranchus ornatus	1	1			1	3
Aricidea lopezi	1	4	2		2	9
Aricidea ramosa						
Armandia brevis						
Artacama coniferi						
Artacamella hancocki						
Asabellides lineata						
Asclerocheilus beringianus						
Autolytinae sp. Indet.						
Barantolla americana	1	7		1		9
Barantolla sp. Juv.				1	1	2
Betapista dekkerae						
Bispira sp. Indet.						
Boccardiella hamata						
Capitella capitata 'hyperspecies'						
Capitellidae sp. Indet./Juv.		1			1	2
Caulleriella pacifica						
Chaetopteridae sp. Indet.						
Chaetopterus nr. variopedatus						
Chaetozone acuta						
Chaetozone nr. setosa	13	13	18	19	12	75
Chaetozone sp. Indet.						
Chone duneri						
Chone sp. Indet.						
Cirratulidae sp. Indet./Juv.	3	3			1	7
Cirratulus sp. Juv.						
Cirratulus spectabilis						
'Clymenura' gracilis	1	1	1	1	2	6
Cossura pygodactylata						
Cossura sp. Indet./Juv.	1	2				3
Diopatra ornata						
Dipolydora akaina						
Dipolydora cardalia		54				54
Dipolydora socialis						
Dorvillea pseudorubrovittata						

	EB60					
TAXON	2529-A	2529-B	2529-C	2529-D	2529-E	SppCount
Dorvillea rudolphi						
Dorvillea sp. Indet.						
Dorvilleidae sp. Indet.	1					1
Drilonereis falcata						
Drilonereis longa						
Ehlersia heterochaeta				1		1
Ehlersia hyperioni					2	2
Epidiopatra hypferiona monroi	1			1		2
Errano bicirrata						
Eteone sp. Indet.	1			1	1	3
Euchone incolor	1	1				2
Euclymeninae sp. Indet./Juv.						
Eulalia californiensis			1		1	2
Eulalia nr. levicornuta	1					1
Eulalia sp. 1						
Eumida longicornuta	1	4		1	1	7
Eusyllis habei						
Exogone lourei	6	3		3	3	15
Exogone molesta						
Galathowenia oculata						
Gattyana ciliata						
Gattyana cirrosa					3	3
Glycera americana						
Glycera nana	9	11	10	10	10	50
Glycinde armigera	3	1	1	3	2	10
Glycinde polygnatha						
Goniada maculata	1					1
Harmothoe fragilis						
Harmothoe imbricata						
Hesionidae sp. Indet./Juv.						
Heteromastus filobranchus		1	2	2	3	8
Idanthyrsus saxicavus						
Isocirrus longiceps			1		1	2
Lanassa nordenskioldi		2			1	3
Lanassa sp. Indet.						
Lanassa venusta	2					2
Laonice cirrata						
Leitoscoloplos pugettensis	4	2	2	5	3	16
Lepidasthenia berkeleyae						
Lepidasthenia longicirrata					2	2
Lepidasthenia sp. Indet./Juv.						
Lepidonotus spiculus						
Levinsenia gracilis	6	4	2	3	4	19
Lumbrineridae sp. Indet./Juv.		5		3	1	9
Lumbrineris californiensis						
Lumbrineris cruzensis						
Lumbrineris limicola						
Lumbrineris sp. Indet.						
Magelona longicornis	4	1		2	1	8
Magelona sp. Juv.						
Maldane sarsi						
Maldanidae sp. Indet./Juv.	9	3	3	2	3	20

	EB60					
TAXON	2529-A	2529-B	2529-C	2529-D	2529-E	SppCount
Maldaninae sp. Indet.						
Malmgreniella bansei						
Malmgreniella berkeleyorum						
Malmgreniella liei						
Malmgreniella sp. Juv.						
Mediomastus ambiseta			1			**1**
Mediomastus californiensis						
Mediomastus sp. Indet.	5	19	1	8		**33**
Megalomma splendida						
Mesochaetopterus taylori						
Metascyhis disparadentata						
Microphthalmus sp. Indet.						
Micropodarke dubia						
Monticellina serratiseta				3		**3**
Monticellina sp. A					2	**2**
Monticellina sp. Indet.					1	**1**
Myriochele heeri	31	50	5	30	5	**121**
Myxicola infundibulum						
Neosabellaria cementarium						
Nephtys cornuta	7	2		5		**14**
Nephtys ferruginea	5	1		4		**10**
Nephtys sp. Indet./Juv.		1			1	**2**
Nereis procera						
Nereis sp. Juv.						
Nereis zonata						
Nicomache personata						
Notocirrus californiensis			1		1	**2**
Notomastus latericius						
Notomastus tenuis	10	8	11	15	6	**50**
Notoproctus pacificus						
Odontosyllis phosphorea						
Oligochaeta sp. Indet.	1					**1**
Onuphidae sp. Indet./Juv.	5	1		1		**7**
Onuphis elegans						
Onuphis iridescens	2	2		1	1	**6**
Onuphis sp. Juv.			1			**1**
Ophelina acuminata						
Owenia fusiformis						
Paleonotus bellis						
Parandalia fauveli	1					**1**
Paraprionospio pinnata	6	3	7	3	5	**24**
Parougia caeca						
Pectianria californiensis	83	72	31	82	52	**320**
Pectinaria granulata			3		2	**5**
Pectinaria sp. Juv.						
Pherusa plumosa						
Pholoe glabra		2		1		**3**
Pholoe sp. Indet.				1		**1**
Pholoides asperus						
Phyllochaetopterus prolifica						
Phyllodoce groenlandica		3		1	1	**5**
Phyllodoce hartmanae	2	1			1	**4**

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB60

	EB60					
TAXON	2529-A	2529-B	2529-C	2529-D	2529-E	SppCount
Phyllodoce sp. Juv.						
Phyllodoce williamsi						
Phylo felix			1			**1**
Pilargis maculata	4	3	1		3	**11**
Pionosyllis uraga						
Pista bansei						
Pista brevibranchiata						
Pista elongata						
Pista sp. Juv.						
Platynereis bicanaliculata					1	**1**
Podarke pugettensis						
Podarkeopsis glabrus			1	1		**2**
Polycirrus californicus		1				**1**
Polycirrus sp. complex	1					**1**
Polydora caulleryi			7	19	4	**30**
Polydora limicola				1	4	**5**
Polydora sp. Indet./Juv.				1		**1**
Polynoidae sp. Indet.						
Praxillella gracilis						
Praxillella pacifica	1		1			**2**
Praxillella sp. Indet.						
Prionospio jubata	30	23	26	28	22	**129**
Prionospio lighti	3	1		2	1	**7**
Prionospio multibranchiata	1					**1**
Prionospio sp. Indet.						
Procerea cornuta	1					**1**
Proclea graffi	5		3	2		**10**
Protodorvillea gracilis						
Pseudopotamilla myriops						
Pseudopotamilla neglecta						
Rhodine bitorquata	1	2		1		**4**
Sabellidae sp. Indet.						
Scalibregma inflatum						
Schistocomus hiltoni						
Scionella japonica						
Scolelepis texana						
Scoletoma luti	22	13	26	7	14	**82**
Sigambra sp. Juv.						
Sigambra tentaculata					1	**1**
Sphaerodoropsis sphaerulifer	19	10	3	19	4	**55**
Sphaerosyllis ranunculus						
Spio cirrifera						
Spiochaetopterus costarum	2	5		1	1	**9**
Spionidae sp. Indet./Juv.						
Spiophanes berkeleyorum						
Spiophanes bombyx	3					**3**
Sternaspis scutata	1					**1**
Sthenalais tertiaglabra		2		4		**6**
Streblosoma bairdi						
Streblosoma sp. Juv.						
Syllidae sp. Indet./Juv.						
Tenonia priops	1	1	2	1		**5**

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB60

TAXON	EB60 2529-A	2529-B	2529-C	2529-D	2529-E	SppCount
Terebellidae sp. Indet./Juv.	1		1			**2**
Terebellides californica						
Tharyx sp. Indet.				2		**2**
Thelepus setosus						
Travisia forbesii						
Travisia sp. Juv.						
Trochochaeta multisetosa	1	2		5		**8**
Typosyllis harti	2		1	1	1	**5**

REPLICATE TPOLYAB	**339**	**361**	**180**	**318**	**205**
REPLICATE TPOLYRC	**55**	**49**	**34**	**49**	**51**
STATION TPOLYAB	**1403**				
STATION TPOLYRC	**91**				

MOLLUSCA

TAXON	2529-A	2529-B	2529-C	2529-D	2529-E	SppCount
Acila castrensis					1	**1**
Adontorhina cyclia						
Aeolidacea sp. 1						
Aeolidacea sp. 2						
Alvania compacta	1	2				**3**
Astarte elliptica						
Astyris gausapata	10	4		1	4	**19**
Axinopsida serricata	534	518	517	682	421	**2672**
Balcis sp. Indet.						
Barleeia sp. Indet.						
Bivalvia sp. Juv.				1		**1**
Boreotrophon sp. Indet.						
Cardiidae sp. Juv.						
Cardiomya pectinata						
Ceratostoma foliatum						
Chaetoderma sp. Indet.	12		3	1		**16**
Chlamys hastata						
Cingula sp. Indet.						
Clinocardium nuttalli						
Clinocardium sp. Juv.						
Compsomyax subdiaphana	4	3	6	11	3	**27**
Crepipatella lingulata						
Cryptonatica affinis						
Cyclocardia ventricosa						
Cylichna attonsa					1	**1**
Delectopecten sp. Juv.						
Delectopecten vancouverensis						
Euspira lewisii						
Galeommatacea sp. Indet.						
Gastropoda sp. Juv.						
Gastropteron pacificum	6	3	1	1	1	**12**
Hiatella arctica	1					**1**
Kurtzia arteaga						
Lirobittium sp. Indet.						
Lucinoma annulatum	10	8	10	8	6	**42**
Lyonsia californica	2	4	3			**9**
Macoma calcarea				1		**1**

	EB60					
TAXON	2529-A	2529-B	2529-C	2529-D	2529-E	SppCount
Macoma carlottensis	67	83	153	180	153	**636**
Macoma elimata	1	7	1	1	3	**13**
Macoma moesta alaskana						
Macoma nasuta						
Macoma obliqua						
Macoma sp. Juv.	74	63	29	53	33	**252**
Macoma yoldiformis	6		2	2	5	**15**
Mactridae sp. Juv.						
Margarites pupillus						
Megacrenella columbiana	25	18	14	27	18	**102**
Musculus discors						
Musculus sp. Juv.						
Mya arenaria						
Mysella tumida	3	8	1	6	2	**20**
Mytilidae sp. Juv.	3	1				**4**
Mytilus sp. Juv.			2	4		**6**
Nassarius mendicus						
Nemocardium centrifilosum	1	1	1	1	3	**7**
Nucula tenuis	8	9	6	14	8	**45**
Nuculana minuta		2		3	1	**6**
Nuculana sp. Indet.					1	**1**
Nudibranchia sp. Indet.						
Odostomia sp. Indet.						
Pandora filosa		1		1	1	**3**
Pandora sp. Juv.						
Parvilucina tenuisculpta	82	91	112	119	80	**484**
Psephidia lordi		1	1		2	**4**
Retusa sp. Indet.						
Rictaxis punctocaelatus			1			**1**
Solen sicarius		1				**1**
Tellina sp. Juv.						
Teredinidae sp. Indet.						
Thracia trapezoides				1		**1**
Thyasira gouldi	1				1	**2**
Trichotopis cancellata						
Turbonilla sp. Indet.		2		1		**3**
Vitreolina columbiana						
Vitrinella columbiana						
Yoldia scissurata		2	1	1	1	**5**
Yoldia sp. Juv.						

REPLICATE TMOLLAB	**851**	**832**	**864**	**1120**	**749**
REPLICATE TMOLLRC	**20**	**22**	**19**	**23**	**22**
STATION TMOLLAB	**4416**				
STATION TMOLLRC	**34**				

CRUSTACEA

Ampelisca agassizi						
Ampelisca brevisimulata						
Ampelisca careyi						
Ampelisca hancocki						
Ampelisca lobata					1	**1**

	EB60					
TAXON	2529-A	2529-B	2529-C	2529-D	2529-E	SppCount
Aoroides intermedia						
Aoroides sp						
Araphura sp A						
Balanomorpha		2	2		119	**123**
Byblis millsi						
Campylaspis hartae						
Campylaspis rubromaculata						
Cancer gracilis						
Cancer sp						
Caprella mendax						
Corophium baconi						
Corophium insidiosum						
Crangon alaskensis						
Crangon sp						
Cyclopoida						
Cyphocaris challengeri						
Deflexilodes enigmaticus						
Desdimelita desdichada						
Desdimelita transmelita						
Diastylis paraspinulosa				1		**1**
Diastylis "santamariensis"		1	1			**2**
Discorsopagurus schmitti						
Dyopedos monacanthus						
Eobrolgus chumashi						
Eochelidium sp A						
Ericthonius brasiliensis						
Ericthonius rubricornis						
Eualus sp						
Eudorella pacifica	5	1	4	4	2	**16**
Eudorellopsis longirostris			1		1	**2**
Euphilomedes carcharodonta	180	191	138	151	150	**810**
Euphilomedes producta	77	94	52	93	50	**366**
Euphilomedes sp						
Eusirus columbianus						
Eyakia robustus						
Haliophasma geminatum			1			**1**
Heptacarpus brevirostris						
Heterophoxus conlanae						
Heterophoxus sp						
Hippolytidae					1	**1**
Hippomedon sp A	3					**3**
Leptochelia dubia			1	3	10	**14**
Leptognathia gracilis						
Leptognathia sp E						
Leucon sp A				2		**2**
Limnoria lignorum						
Lophopanopeus sp						
Majidae						
Mayerella banksia						
Melphisana "bola"						
Mesocrangon munitella						
Metacaprella anomala						

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB60

TAXON	EB60 2529-A	2529-B	2529-C	2529-D	2529-E	SppCount
Metaphoxus frequens						
Microjassa litotes						
Munna fernaldi						
Munnogonium tillerae						
Mysidae						
Mysidella americana						
Nebalia "pugettensis"						
Neotrypaea sp						
Orchomene decipiens						
Orchomene pacifica						
Orchomene pinguis						
Oregonia gracilis						
Pachynus barnardi						
Pagurus sp						
Parametaphoxus quaylei						
Parasterope barnesi	2		1	5		**8**
Pardalisca tenuipes						
Photis brevipes						
Photis macrotica						
Photis sp						
Pinnixa occidentalis						
Pinnixa schmitti						
Pinnixa sp	1	3	1	1	1	**7**
Pinnotheridae						
Pleurogonium californiense				1		**1**
Pleurogonium rubicundum						
Pleusymtes sp A						
Prachynella lodo						
Protomedeia prudens						
Protomedeia sp						
Rutiderma lomae	6	2	6	10	2	**26**
Scoloura phillipsi						
Solidobalanus hesperius		8	3		1	**12**
Spirontocaris sp						
Synchelidium pectinatum						
Synchelidium rectipalmum						
Synchelidium sp						
Upogebia pugettensis						
Westwoodilla caecula	2		1	2	2	**7**

REPLICATE TCRSTAB	**276**	**302**	**212**	**273**	**340**
REPLICATE TCRSTRC	**8**	**8**	**13**	**11**	**12**
STATION TCRSTAB	**1403**				
STATION TCRSTRC	**19**				

MISCELLANEOUS

Amphiodia *periercta*	10	4	6	6	9	**35**
Amphiodia sp. Indet.	15	12	6	15	9	**57**
Amphipholis sp. Indet.						**0**
Amphipholis squamata						**0**
Amphiuridae sp. Indet.						**0**
Anthozoa sp. Indet.						**0**

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB60

	EB60					
TAXON	2529-A	2529-B	2529-C	2529-D	2529-E	SppCount
Arhynchite pugettensis						0
Asteroidea sp. Juv.						0
Brachiopoda sp. Indet.						0
Chiridota sp. Indet.						0
Cucumaria piperata						0
Cucumaria sp. Indet.						0
Dendrochirotida sp. Indet.						0
Golfingia sp. Indet.				1		1
Hirudinea sp. Indet.						0
Leptosynapta clarki						0
Leptosynapta transgressor						0
Nemertinea sp. Indet.	7	5	8	7	7	34
Nynantheae sp. Indet.						0
Ophiura lutkeni						0
Ophiura sp. Indet.		1				1
Ophiurida sp. Indet.	33	30	6	13	13	95
Pachycerianthus fimbriata						0
Pentamera cf. pseudopopulifera	1				1	2
Pentamera sp. Indet.						0
Pentamera trachyplaca						0
Phoronida sp. Indet.						0
Phoronis sp. Indet.						0
Platyhelminthes sp. Indet.	1					1
Sipunculida sp. Indet.	1			3		4
Solasteridae sp. Indet.						0
Thysanocardia nigra						0
Turbellaria sp. Indet.			1			1

REPLICATE TMISCAB	68	52	27	45	39
REPLICATE TMISCRC	7	5	5	6	5
STATION TMISCAB	231				
STATION TMISCRC	33				
REPLICATE TABUND	1534	1547	1283	1756	1333
REPLICATE TRICH	90	84	71	89	90
STATION TABUND	7453				
STATION TRICH	177				

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB67

TAXON	EB67 2531-A	2531-B	2531-C	2531-D	2531-E	SppCount
POLYCHAETA						
Amage anops			1		1	**2**
Ampharete finmarchica					1	**1**
Ampharete labrops						
Ampharete nr. crassiseta						
Ampharete sp. Indet./Juv.			2			**2**
Ampharetidae sp. Indet./Juv.						
Amphicteis mucronata						
Amphitrite edwardsi						
Amphitrite robusta						
Anobothrus gracilis	5	1	2	1	3	**12**
Aphelochaeta monilaris			2	3		**5**
Aphelochaeta sp. 2						
Aphelochaeta sp. Indet.	2	5				**7**
Aphelochaeta sp. N-1						
Aphrodita japonica						
Aphrodita sp. Juv.						
Apistobranchus ornatus		1			1	**2**
Aricidea lopezi	3	2	7	1	5	**18**
Aricidea ramosa	1	1				**2**
Armandia brevis						
Artacama coniferi				1	1	**2**
Artacamella hancocki						
Asabellides lineata						
Asclerocheilus beringianus						
Autolytinae sp. Indet.						
Barantolla americana	2		2	1	3	**8**
Barantolla sp. Juv.						
Betapista dekkerae						
Bispira sp. Indet.						
Boccardiella hamata				2		**2**
Capitella capitata 'hyperspecies'						
Capitellidae sp. Indet./Juv.	2	1	1		2	**6**
Caulleriella pacifica						
Chaetopteridae sp. Indet.						
Chaetopterus nr. variopedatus						
Chaetozone acuta						
Chaetozone nr. setosa	5	4	2	7	7	**25**
Chaetozone sp. Indet.						
Chone duneri						
Chone sp. Indet.						
Cirratulidae sp. Indet./Juv.	1		1	8	4	**14**
Cirratulus sp. Juv.						
Cirratulus spectabilis						
'Clymenura' gracilis	1	2	1	2	2	**8**
Cossura pygodactylata						
Cossura sp. Indet./Juv.						
Diopatra ornata						
Dipolydora akaina						
Dipolydora cardalia	1			1		**2**
Dipolydora socialis						
Dorvillea pseudorubrovittata						

TAXON	2531-A	2531-B	2531-C	2531-D	2531-E	SppCount
				EB67		
Dorvillea rudolphi						
Dorvillea sp. Indet.						
Dorvilleidae sp. Indet..						
Drilonereis falcata						
Drilonereis longa	1	1				2
Ehlersia heterochaeta		2				2
Ehlersia hyperioni						
Epidiopatra hypferiona monroi						
Errano bicirrata						
Eteone sp. Indet.					1	1
Euchone incolor						
Euclymeninae sp. Indet./Juv.	7			8	1	16
Eulalia californiensis						
Eulalia nr. levicornuta						
Eulalia sp. 1						
Eumida longicornuta	2			3	2	7
Eusyllis habei						
Exogone lourei	1				2	3
Exogone molesta						
Galathowenia oculata						
Gattyana ciliata						
Gattyana cirrosa						
Glycera americana		1				1
Glycera nana	12	10	8	14	11	55
Glycinde armigera		1		1		2
Glycinde polygnatha						
Goniada maculata						
Harmothoe fragilis						
Harmothoe imbricata						
Hesionidae sp. Indet./Juv.						
Heteromastus filobranchus		2			1	3
Idanthyrsus saxicavus						
Isocirrus longiceps						
Lanassa nordenskioldi			18	2	4	24
Lanassa sp. Indet.						
Lanassa venusta				12	20	32
Laonice cirrata				2	2	4
Leitoscoloplos pugettensis	1	5		1	1	8
Lepidasthenia berkeleyae						
Lepidasthenia longicirrata						
Lepidasthenia sp. Indet./Juv.						
Lepidonotus spiculus						
Levinsenia gracilis		5	3	2	3	13
Lumbrineridae sp. Indet./Juv.		2	2	3	1	8
Lumbrineris californiensis						
Lumbrineris cruzensis					1	1
Lumbrineris limicola						
Lumbrineris sp. Indet.						
Magelona longicornis				2	2	4
Magelona sp. Juv.						
Maldane sarsi		1				1
Maldanidae sp. Indet./Juv.	3	5	3		6	17

	EB67					
TAXON	2531-A	2531-B	2531-C	2531-D	2531-E	SppCount
Maldaninae sp. Indet.					1	1
Malmgreniella bansei						
Malmgreniella berkeleyorum				1		1
Malmgreniella liei						
Malmgreniella sp. Juv.		1				1
Mediomastus ambiseta						
Mediomastus californiensis						
Mediomastus sp. Indet.	5	3	2	2	5	17
Megalomma splendida	4	2		1	2	9
Mesochaetopterus taylori						
Metascyhis disparadentata						
Microphthalmus sp. Indet.				2		2
Micropodarke dubia						
Monticellina serratiseta					2	2
Monticellina sp. A						
Monticellina sp. Indet.						
Myriochele heeri	26	4	17	1	22	70
Myxicola infundibulum						
Neosabellaria cementarium						
Nephtys cornuta	1	3	2	1	2	9
Nephtys ferruginea	3	2			3	8
Nephtys sp. Indet./Juv.			2	2	4	8
Nereis procera						
Nereis sp. Juv.						
Nereis zonata						
Nicomache personata						
Notocirrus californiensis						
Notomastus latericius						
Notomastus tenuis	3	6	3	1	4	17
Notoproctus pacificus						
Odontosyllis phosphorea						
Oligochaeta sp. Indet.			2			2
Onuphidae sp. Indet./Juv.	4	3		2	6	15
Onuphis elegans						
Onuphis iridescens		1	2	1		4
Onuphis sp. Juv.						
Ophelina acuminata				1		1
Owenia fusiformis						
Paleonotus bellis						
Parandalia fauveli						
Paraprionospio pinnata	3	8	1	7	4	23
Parougia caeca						
Pectianria californiensis	74	30	51	19	82	256
Pectinaria granulata					1	1
Pectinaria sp. Juv.						
Pherusa plumosa		1				1
Pholoe glabra	3				1	4
Pholoe sp. Indet.					1	1
Pholoides asperus						
Phyllochaetopterus prolifica						
Phyllodoce groenlandica	1	1		1	2	5
Phyllodoce hartmanae	1		1			2

	EB67					
TAXON	2531-A	2531-B	2531-C	2531-D	2531-E	SppCount
Phyllodoce sp. Juv.						
Phyllodoce williamsi						
Phylo felix						
Pilargis maculata		3	2			5
Pionosyllis uraga						
Pista bansei						
Pista brevibranchiata				1		1
Pista elongata						
Pista sp. Juv.						
Platynereis bicanaliculata						
Podarke pugettensis						
Podarkeopsis glabrus		1	1			2
Polycirrus californicus		2	2	1	5	10
Polycirrus sp. complex			2			2
Polydora caulleryi			8		9	17
Polydora limicola						
Polydora sp. Indet./Juv.						
Polynoidae sp. Indet.						
Praxillella gracilis						
Praxillella pacifica					2	2
Praxillella sp. Indet.						
Prionospio jubata	14	14	14	14	17	73
Prionospio lighti			5			5
Prionospio multibranchiata						
Prionospio sp. Indet.						
Procerea cornuta		1				1
Proclea graffi	22	30		23	16	91
Protodorvillea gracilis						
Pseudopotamilla myriops						
Pseudopotamilla neglecta						
Rhodine bitorquata	3	2	1	2	1	9
Sabellidae sp. Indet.						
Scalibregma inflatum						
Schistocomus hiltoni						
Scionella japonica						
Scolelepis texana						
Scoletoma luti	9	12	1	6	12	40
Sigambra sp. Juv.						
Sigambra tentaculata			2			2
Sphaerodoropsis sphaerulifer	6	4	3		6	19
Sphaerosyllis ranunculus						
Spio cirrifera		1			1	2
Spiochaetopterus costarum	4		1	4	8	17
Spionidae sp. Indet./Juv.						
Spiophanes berkeleyorum						
Spiophanes bombyx						
Sternaspis scutata						
Sthenalais tertiaglabra		1			1	2
Streblosoma bairdi						
Streblosoma sp. Juv.						
Syllidae sp. Indet./Juv.						
Tenonia priops		1				1

TAXON	2531-A	2531-B	2531-C	2531-D	2531-E	SppCount
			EB67			
Terebellidae sp. Indet./Juv.	2			4	5	11
Terebellides californica	2	2			3	7
Tharyx sp. Indet.						
Thelepus setosus						
Travisia forbesii				1		1
Travisia sp. Juv.						
Trochochaeta multisetosa	2	3		5	2	12
Typosyllis harti						

REPLICATE TPOLYAB	**242**	**194**	**180**	**180**	**318**
REPLICATE TPOLYRC	**38**	**46**	**37**	**45**	**56**
STATION TPOLYAB	**1114**				
STATION TPOLYRC	**84**				

MOLLUSCA

Acila castrensis						
Adontorhina cyclia					1	1
Aeolidacea sp. 1						
Aeolidacea sp. 2						
Alvania compacta			1		1	2
Astarte elliptica						
Astyris gausapata			7	3	2	12
Axinopsida serricata	309	304	274	379	511	1777
Balcis sp. Indet.						
Barleeia sp. Indet.						
Bivalvia sp. Juv.						
Boreotrophon sp. Indet.						
Cardiidae sp. Juv.						
Cardiomya pectinata		1			2	3
Ceratostoma foliatum						
Chaetoderma sp. Indet.	3	2	2	3	4	14
Chlamys hastata						
Cingula sp. Indet.						
Clinocardium nuttalli						
Clinocardium sp. Juv.						
Compsomyax subdiaphana	8	7	8	2	12	37
Crepipatella lingulata						
Cryptonatica affinis						
Cyclocardia ventricosa						
Cylichna attonsa						
Delectopecten sp. Juv.						
Delectopecten vancouverensis						
Euspira lewisii		1				1
Galeommatacea sp. Indet.						
Gastropoda sp. Juv.						
Gastropteron pacificum	1	4	1	4	5	15
Hiatella arctica						
Kurtzia arteaga						
Lirobittium sp. Indet.						
Lucinoma annulatum	13	6	2	9	4	34
Lyonsia californica	2		2	1		5
Macoma calcarea						

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB67

	EB67					
TAXON	2531-A	2531-B	2531-C	2531-D	2531-E	SppCount
Macoma carlottensis	3	17	10	122	191	343
Macoma elimata	1			3	1	5
Macoma moesta alaskana						
Macoma nasuta						
Macoma obliqua						
Macoma sp. Juv.	103	108	118	159	121	609
Macoma yoldiformis	1	3		7	3	14
Mactridae sp. Juv.						
Margarites pupillus						
Megacrenella columbiana	15	9	3	12	7	46
Musculus discors						
Musculus sp. Juv.						
Mya arenaria						
Mysella tumida			1	1	1	3
Mytilidae sp. Juv.						
Mytilus sp. Juv.						
Nassarius mendicus						
Nemocardium centrifilosum	5	1	2	6	7	21
Nucula tenuis	2	3	4	2	6	17
Nuculana minuta	1	2			2	5
Nuculana sp. Indet.						
Nudibranchia sp. Indet.						
Odostomia sp. Indet.						
Pandora filosa						
Pandora sp. Juv.						
Parvilucina tenuisculpta	15	19	14	15	19	82
Psephidia lordi					1	1
Retusa sp. Indet.						
Rictaxis punctocaelatus						
Solen sicarius						
Tellina sp. Juv.		1				1
Teredinidae sp. Indet.						
Thracia trapezoides						
Thyasira gouldi						
Trichotopis cancellata						
Turbonilla sp. Indet.	1			1	2	4
Vitreolina columbiana						
Vitrinella columbiana						
Yoldia scissurata	1	1	1	1	3	7
Yoldia sp. Juv.						

REPLICATE TMOLLAB	**484**	**489**	**450**	**730**	**906**
REPLICATE TMOLLRC	**17**	**17**	**16**	**18**	**22**
STATION TMOLLAB	**3059**				
STATION TMOLLRC	**25**				

CRUSTACEA

Ampelisca agassizi						
Ampelisca brevisimulata						
Ampelisca careyi						
Ampelisca hancocki					1	1
Ampelisca lobata						

	EB67					
TAXON	2531-A	2531-B	2531-C	2531-D	2531-E	SppCount
Aoroides intermedia	1					1
Aoroides sp						
Araphura sp A		1			1	2
Balanomorpha						
Byblis millsi	1					1
Campylaspis hartae						
Campylaspis rubromaculata						
Cancer gracilis	2					2
Cancer sp			1			1
Caprella mendax						
Corophium baconi						
Corophium insidiosum						
Crangon alaskensis						
Crangon sp						
Cyclopoida						
Cyphocaris challengeri						
Deflexilodes enigmaticus	2					2
Desdimelita desdichada						
Desdimelita transmelita						
Diastylis paraspinulosa	1	1			1	3
Diastylis "santamariensis"	2					2
Discorsopagurus schmitti						
Dyopedos monacanthus	1					1
Eobrolgus chumashi						
Eochelidium sp A						
Ericthonius brasiliensis						
Ericthonius rubricornis						
Eualus sp						
Eudorella pacifica	14	7	5	6	20	52
Eudorellopsis longirostris			2		3	5
Euphilomedes carcharodonta	175	48	47	105	129	504
Euphilomedes producta	86	76	55	112	117	446
Euphilomedes sp						
Eusirus columbianus						
Eyakia robustus						
Haliophasma geminatum	3	1		1	1	6
Heptacarpus brevirostris						
Heterophoxus conlanae	3					3
Heterophoxus sp						
Hippolytidae						
Hippomedon sp A	3	5		3	4	15
Leptochelia dubia						
Leptognathia gracilis						
Leptognathia sp E						
Leucon sp A			1		1	2
Limnoria lignorum						
Lophopanopeus sp						
Majidae						
Mayerella banksia					1	1
Melphisana "bola"						
Mesocrangon munitella						
Metacaprella anomala						

TAXON	EB67 2531-A	2531-B	2531-C	2531-D	2531-E	SppCount
Metaphoxus frequens	1			2		3
Microjassa litotes						
Munna fernaldi						
Munnogonium tillerae						
Mysidae				1		1
Mysidella americana						
Nebalia "pugettensis"						
Neotrypaea sp					1	1
Orchomene decipiens						
Orchomene pacifica						
Orchomene pinguis						
Oregonia gracilis						
Pachynus barnardi						
Pagurus sp					1	1
Parametaphoxus quaylei						
Parasterope barnesi	1	1				2
Pardalisca tenuipes						
Photis brevipes						
Photis macrotica						
Photis sp						
Pinnixa occidentalis						
Pinnixa schmitti	3					3
Pinnixa sp	7	3	3	1	1	15
Pinnotheridae						
Pleurogonium californiense						
Pleurogonium rubicundum						
Pleusymtes sp A						
Prachynella lodo						
Protomedeia prudens						
Protomedeia sp						
Rutiderma lomae	10	7	4	1	2	24
Scoloura phillipsi	1					1
Solidobalanus hesperius						
Spirontocaris sp						
Synchelidium pectinatum		1				1
Synchelidium rectipalmum	1					1
Synchelidium sp						
Upogebia pugettensis	2	1			1	4
Westwoodilla caecula	1				1	2

REPLICATE TCRSTAB	**321**	**152**	**118**	**232**	**286**
REPLICATE TCRSTRC	**22**	**12**	**8**	**9**	**17**
STATION TCRSTAB	**1109**				
STATION TCRSTRC	**32**				

MISCELLANEOUS

Amphiodia periercta	3		1	2	4	10
Amphiodia sp. Indet.	4	2	3	12	15	36
Amphipholis sp. Indet.						0
Amphipholis squamata						0
Amphiuridae sp. Indet.						0
Anthozoa sp. Indet.						0

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB67

TAXON	2531-A	2531-B	2531-C	2531-D	2531-E	SppCount
			EB67			
Arhynchite pugettensis		1				1
Asteroidea sp. Juv.						0
Brachiopoda sp. Indet.						0
Chiridota sp. Indet.						0
Cucumaria piperata						0
Cucumaria sp. Indet.						0
Dendrochirotida sp. Indet.						0
Golfingia sp. Indet.						0
Hirudinea sp. Indet.						0
Leptosynapta clarki						0
Leptosynapta transgressor						0
Nemertinea sp. Indet.	9	9	2	3	3	26
Nynantheae sp. Indet.						0
Ophiura lutkeni						0
Ophiura sp. Indet.						0
Ophiurida sp. Indet.	30	6	14	25	17	92
Pachycerianthus fimbriata						0
Pentamera cf. pseudopopulifera	1		1	1		3
Pentamera sp. Indet.						0
Pentamera trachyplaca						0
Phoronida sp. Indet.						0
Phoronis sp. Indet.						0
Platyhelminthes sp. Indet.	5	8				13
Sipunculida sp. Indet.		3	2	3	5	13
Solasteridae sp. Indet.						0
Thysanocardia nigra						0
Turbellaria sp. Indet.						0

REPLICATE TMISCAB	**52**	**29**	**23**	**46**	**44**
REPLICATE TMISCRC	**6**	**6**	**6**	**6**	**5**
STATION TMISCAB	**194**				
STATION TMISCRC	**33**				
REPLICATE TABUND	**1099**	**864**	**771**	**1188**	**1554**
REPLICATE TRICH	**83**	**81**	**67**	**78**	**100**
STATION TABUND	**5476**				
STATION TRICH	**174**				

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB77

TAXON	EB77 2533-A	2533-B	2533-C	2533-D	2533-E	SppCount
POLYCHAETA						
Amage anops						
Ampharete finmarchica						
Ampharete labrops						
Ampharete nr. crassiseta			1			1
Ampharete sp. Indet./Juv.					1	1
Ampharetidae sp. Indet./Juv.						
Amphicteis mucronata						
Amphitrite edwardsi						
Amphitrite robusta						
Anobothrus gracilis	4	4	3	4	1	16
Aphelochaeta monilaris		1	2	2	4	9
Aphelochaeta sp. 2						
Aphelochaeta sp. Indet.	8					8
Aphelochaeta sp. N-1					2	2
Aphrodita japonica						
Aphrodita sp. Juv.						
Apistobranchus ornatus			1			1
Aricidea lopezi	2	1	5			8
Aricidea ramosa	1			1		2
Armandia brevis						
Artacama coniferi						
Artacamella hancocki						
Asabellides lineata						
Asclerocheilus beringianus						
Autolytinae sp. Indet.						
Barantolla americana	2		1	1	1	5
Barantolla sp. Juv.						
Betapista dekkerae						
Bispira sp. Indet.						
Boccardiella hamata	2	2	2	1	2	9
Capitella capitata 'hyperspecies'						
Capitellidae sp. Indet./Juv.		1				1
Caulleriella pacifica						
Chaetopteridae sp. Indet.						
Chaetopterus nr. variopedatus						
Chaetozone acuta						
Chaetozone nr. setosa	11	10	13	11	5	50
Chaetozone sp. Indet.						
Chone duneri						
Chone sp. Indet.	1					1
Cirratulidae sp. Indet./Juv.	3	9	7	12	9	40
Cirratulus sp. Juv.						
Cirratulus spectabilis						
'Clymenura' gracilis	8	7	4	8	6	33
Cossura pygodactylata						
Cossura sp. Indet./Juv.						
Diopatra ornata		1	2		2	5
Dipolydora akaina		1				1
Dipolydora cardalia	4		3		2	9
Dipolydora socialis			2			2
Dorvillea pseudorubrovittata						

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB77

	EB77					
TAXON	2533-A	2533-B	2533-C	2533-D	2533-E	SppCount
Dorvillea rudolphi						
Dorvillea sp. Indet.						
Dorvilleidae sp. Indet.						
Drilonereis falcata			1			1
Drilonereis longa						
Ehlersia heterochaeta	1				1	2
Ehlersia hyperioni	1		2		1	4
Epidiopatra hypferiona monroi						
Errano bicirrata				1		1
Eteone sp. Indet.	1	2		5	3	11
Euchone incolor						
Euclymeninae sp. Indet./Juv.						
Eulalia californiensis						
Eulalia nr. levicornuta						
Eulalia sp. 1						
Eumida longicornuta	1			1	1	3
Eusyllis habei						
Exogone lourei	1	2	2	3	9	17
Exogone molesta						
Galathowenia oculata						
Gattyana ciliata						
Gattyana cirrosa						
Glycera americana						
Glycera nana	11	7	11	11	8	48
Glycinde armigera	4	3	1	1		9
Glycinde polygnatha						
Goniada maculata					1	1
Harmothoe fragilis						
Harmothoe imbricata						
Hesionidae sp. Indet./Juv.						
Heteromastus filobranchus						
Idanthyrsus saxicavus						
Isocirrus longiceps						
Lanassa nordenskioldi	9	2	5	6	6	28
Lanassa sp. Indet.						
Lanassa venusta		18		1		19
Laonice cirrata						
Leitoscoloplos pugettensis	2	3	1	1	1	8
Lepidasthenia berkeleyae						
Lepidasthenia longicirrata						
Lepidasthenia sp. Indet./Juv.						
Lepidonotus spiculus						
Levinsenia gracilis		1	1	1		3
Lumbrineridae sp. Indet./Juv.		3	1		5	9
Lumbrineris californiensis						
Lumbrineris cruzensis						
Lumbrineris limicola						
Lumbrineris sp. Indet.						
Magelona longicornis			2			2
Magelona sp. Juv.						
Maldane sarsi				2		2
Maldanidae sp. Indet./Juv.	2	3	2	1	1	9

			EB77			
TAXON	2533-A	2533-B	2533-C	2533-D	2533-E	SppCount
Maldaninae sp. Indet.						
Malmgreniella bansei					1	1
Malmgreniella berkeleyorum					1	1
Malmgreniella liei						
Malmgreniella sp. Juv.						
Mediomastus ambiseta						
Mediomastus californiensis						
Mediomastus sp. Indet.	3	4	3	6	4	20
Megalomma splendida	1	1	3	1		6
Mesochaetopterus taylori						
Metascyhis disparadentata						
Microphthalmus sp. Indet.	2					2
Micropodarke dubia						
Monticellina serratiseta		2		2	1	5
Monticellina sp. A						
Monticellina sp. Indet.						
Myriochele heeri	28	56	17	46	35	182
Myxicola infundibulum						
Neosabellaria cementarium						
Nephtys cornuta	4	6	2	4	2	18
Nephtys ferruginea	7	7	10	6	7	37
Nephtys sp. Indet./Juv.	6	1	2	3	6	18
Nereis procera						
Nereis sp. Juv.						
Nereis zonata						
Nicomache personata						
Notocirrus californiensis			1			1
Notomastus latericius						
Notomastus tenuis	12	15	13	4	12	56
Notoproctus pacificus						
Odontosyllis phosphorea						
Oligochaeta sp. Indet.		1				1
Onuphidae sp. Indet./Juv.	5	9	3	11	5	33
Onuphis elegans						
Onuphis iridescens	3	2	5	3	11	24
Onuphis sp. Juv.						
Ophelina acuminata				1		1
Owenia fusiformis				1	1	2
Paleonotus bellis						
Parandalia fauveli	1	1			1	3
Paraprionospio pinnata	9	7	10	7	10	43
Parougia caeca						
Pectinaria californiensis	44	100	35	88	51	318
Pectinaria granulata	5		6	4	3	18
Pectinaria sp. Juv.						
Pherusa plumosa						
Pholoe glabra		1	1	1	1	4
Pholoe sp. Indet.						
Pholoides asperus					1	1
Phyllochaetopterus prolifica						
Phyllodoce groenlandica	1		2	1	3	7
Phyllodoce hartmanae						

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB77

	EB77					
TAXON	2533-A	2533-B	2533-C	2533-D	2533-E	SppCount
Phyllodoce sp. Juv.						
Phyllodoce williamsi						
Phylo felix				1		1
Pilargis maculata	2		3	1		6
Pionosyllis uraga						
Pista bansei			3			3
Pista brevibranchiata					1	1
Pista elongata			1			1
Pista sp. Juv.						
Platynereis bicanaliculata						
Podarke pugettensis						
Podarkeopsis glabrus	1		1	1		3
Polycirrus californicus		2	3	10	4	19
Polycirrus sp. complex	3	1			1	5
Polydora caulleryi			1		1	2
Polydora limicola						
Polydora sp. Indet./Juv.				1	1	2
Polynoidae sp. Indet.						
Praxillella gracilis					1	1
Praxillella pacifica				1		1
Praxillella sp. Indet.						
Prionospio jubata	46	48	45	45	44	228
Prionospio lighti			2			2
Prionospio multibranchiata						
Prionospio sp. Indet.						
Procerea cornuta						
Proclea graffi	10	8	9	4	6	37
Protodorvillea gracilis						
Pseudopotamilla myriops						
Pseudopotamilla neglecta						
Rhodine bitorquata	4	2	1	1	1	9
Sabellidae sp. Indet.						
Scalibregma inflatum						
Schistocomus hiltoni						
Scionella japonica						
Scolelepis texana						
Scoletoma luti	10	6	8	7	11	42
Sigambra sp. Juv.						
Sigambra tentaculata	1		1	1		3
Sphaerodoropsis sphaerulifer	13	14	7	5	15	54
Sphaerosyllis ranunculus						
Spio cirrifera						
Spiochaetopterus costarum	3	9	3	5	10	30
Spionidae sp. Indet./Juv.			1			1
Spiophanes berkeleyorum	1					1
Spiophanes bombyx						
Sternaspis scutata						
Sthenalais tertiaglabra		1	1			2
Streblosoma bairdi						
Streblosoma sp. Juv.						
Syllidae sp. Indet./Juv.				1		1
Tenonia priops			1	2	1	4

	EB77					
TAXON	2533-A	2533-B	2533-C	2533-D	2533-E	SppCount
Terebellidae sp. Indet./Juv.	2	5			3	**10**
Terebellides californica					1	**1**
Tharyx sp. Indet.					1	**1**
Thelepus setosus						
Travisia forbesii						
Travisia sp. Juv.						
Trochochaeta multisetosa	4	3	1	1	2	**11**
Typosyllis harti	1	1				**2**

REPLICATE TPOLYAB	**311**	**394**	**280**	**350**	**332**
REPLICATE TPOLYRC	**50**	**47**	**57**	**53**	**58**
STATION TPOLYAB	**1667**				
STATION TPOLYRC	**92**				

MOLLUSCA

Acila castrensis				1	1	**2**
Adontorhina cyclia					1	**1**
Aeolidacea sp. 1						
Aeolidacea sp. 2						
Alvania compacta	4	1		6	3	**14**
Astarte elliptica						
Astyris gausapata		4		5	3	**12**
Axinopsida serricata	187	226	154	272	206	**1045**
Balcis sp. Indet.						
Barleeia sp. Indet.						
Bivalvia sp. Juv.	4	1	1		1	**7**
Boreotrophon sp. Indet.						
Cardiidae sp. Juv.					1	**1**
Cardiomya pectinata						
Ceratostoma foliatum						
Chaetoderma sp. Indet.			3	2		**5**
Chlamys hastata						
Cingula sp. Indet.						
Clinocardium nuttalli						
Clinocardium sp. Juv.						
Compsomyax subdiaphana	4	2	4	7	3	**20**
Crepipatella lingulata						
Cryptonatica affinis						
Cyclocardia ventricosa						
Cylichna attonsa						
Delectopecten sp. Juv.						
Delectopecten vancouverensis						
Euspira lewisii						
Galeommatacea sp. Indet.						
Gastropoda sp. Juv.		1		2		**3**
Gastropteron pacificum	2				6	**8**
Hiatella arctica		1		1	1	**3**
Kurtzia arteaga						
Lirobittium sp. Indet.						
Lucinoma annulatum	4	5	9	7	12	**37**
Lyonsia californica	2	3	1	7	2	**15**
Macoma calcarea						

	EB77					
TAXON	2533-A	2533-B	2533-C	2533-D	2533-E	SppCount
Macoma carlottensis	2	41	1	152	160	**356**
Macoma elimata	1	4		3	2	**10**
Macoma moesta alaskana						
Macoma nasuta						
Macoma obliqua						
Macoma sp. Juv.	236	279	170	173	87	**945**
Macoma yoldiformis		6	2	6	4	**18**
Mactridae sp. Juv.						
Margarites pupillus						
Megacrenella columbiana	17	17	9	14	17	**74**
Musculus discors						
Musculus sp. Juv.						
Mya arenaria		1				**1**
Mysella tumida	1					**1**
Mytilidae sp. Juv.						
Mytilus sp. Juv.						
Nassarius mendicus						
Nemocardium centrifilosum	3	7	3	11	13	**37**
Nucula tenuis	12	18	8	12	10	**60**
Nuculana minuta	1	11	2	9	5	**28**
Nuculana sp. Indet.						
Nudibranchia sp. Indet.						
Odostomia sp. Indet.						
Pandora filosa						
Pandora sp. Juv.					1	**1**
Parvilucina tenuisculpta	18	17	13	21	31	**100**
Psephidia lordi				1		**1**
Retusa sp. Indet.						
Rictaxis punctocaelatus						
Solen sicarius						
Tellina sp. Juv.					1	**1**
Teredinidae sp. Indet.						
Thracia trapezoides						
Thyasira gouldi						
Trichotopis cancellata						
Turbonilla sp. Indet.	1	2		3	1	**7**
Vitreolina columbiana						
Vitrinella columbiana						
Yoldia scissurata	2	1			4	**7**
Yoldia sp. Juv.						

REPLICATE TMOLLAB	**601**	**648**	**380**	**715**	**576**
REPLICATE TMOLLRC	**18**	**21**	**14**	**21**	**25**
STATION TMOLLAB	**2820**				
STATION TMOLLRC	**30**				

CRUSTACEA

Ampelisca agassizi						
Ampelisca brevisimulata						
Ampelisca careyi					1	**1**
Ampelisca hancocki						
Ampelisca lobata						

	EB77					
TAXON	2533-A	2533-B	2533-C	2533-D	2533-E	SppCount
Aoroides intermedia						
Aoroides sp			3			**3**
Araphura sp A						
Balanomorpha						
Byblis millsi					1	**1**
Campylaspis hartae						
Campylaspis rubromaculata		1				**1**
Cancer gracilis						
Cancer sp						
Caprella mendax						
Corophium baconi						
Corophium insidiosum						
Crangon alaskensis						
Crangon sp						
Cyclopoida						
Cyphocaris challengeri						
Deflexilodes enigmaticus						
Desdimelita desdichada						
Desdimelita transmelita						
Diastylis paraspinulosa			2		1	**3**
Diastylis "santamariensis"						
Discorsopagurus schmitti						
Dyopedos monacanthus						
Eobrolgus chumashi						
Eochelidium sp A						
Ericthonius brasiliensis						
Ericthonius rubricornis						
Eualus sp						
Eudorella pacifica	16	16	5	14	13	**64**
Eudorellopsis longirostris	2		1	2	2	**7**
Euphilomedes carcharodonta	161	124	56	176	136	**653**
Euphilomedes producta	216	179	88	174	229	**886**
Euphilomedes sp						
Eusirus columbianus						
Eyakia robustus						
Haliophasma geminatum		1		1	1	**3**
Heptacarpus brevirostris						
Heterophoxus conlanae	1					**1**
Heterophoxus sp						
Hippolytidae						
Hippomedon sp A	1			1		**2**
Leptochelia dubia						
Leptognathia gracilis		1				**1**
Leptognathia sp E						
Leucon sp A					1	**1**
Limnoria lignorum						
Lophopanopeus sp						
Majidae						
Mayerella banksia	2	1				**3**
Melphisana "bola"						
Mesocrangon munitella						
Metacaprella anomala						

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB77

	EB77					
TAXON	2533-A	2533-B	2533-C	2533-D	2533-E	SppCount
Metaphoxus frequens	1				5	**6**
Microjassa litotes						
Munna fernaldi						
Munnogonium tillerae						
Mysidae						
Mysidella americana						
Nebalia "pugettensis"	1				1	**2**
Neotrypaea sp			2	1		**3**
Orchomene decipiens						
Orchomene pacifica		1		1		**2**
Orchomene pinguis						
Oregonia gracilis						
Pachynus barnardi						
Pagurus sp						
Parametaphoxus quaylei						
Parasterope barnesi		1	1	2		**4**
Pardalisca tenuipes						
Photis brevipes						
Photis macrotica						
Photis sp						
Pinnixa occidentalis						
Pinnixa schmitti						
Pinnixa sp					2	**2**
Pinnotheridae						
Pleurogonium californiense						
Pleurogonium rubicundum	1					**1**
Pleusymtes sp A						
Prachynella lodo						
Protomedeia prudens	1					**1**
Protomedeia sp					1	**1**
Rutiderma lomae	21	13	16	22	33	**105**
Scoloura phillipsi	2			2		**4**
Solidobalanus hesperius						
Spirontocaris sp						
Synchelidium pectinatum					1	**1**
Synchelidium rectipalmum						
Synchelidium sp						
Upogebia pugettensis						
Westwoodilla caecula	1			1	2	**4**

REPLICATE TCRSTAB	**427**	**338**	**174**	**397**	**430**
REPLICATE TCRSTRC	**14**	**10**	**9**	**12**	**16**
STATION TCRSTAB	**1766**				
STATION TCRSTRC	**28**				

MISCELLANEOUS

Amphiodia periercta				5	1	**6**
Amphiodia sp. Indet.		2	1		2	**5**
Amphipholis sp. Indet.						
Amphipholis squamata						
Amphiuridae sp. Indet.						
Anthozoa sp. Indet.						

	EB77					
TAXON	2533-A	2533-B	2533-C	2533-D	2533-E	SppCount
Arhynchite pugettensis						
Asteroidea sp. Juv.						
Brachiopoda sp. Indet.						
Chiridota sp. Indet.						
Cucumaria piperata						
Cucumaria sp. Indet.						
Dendrochirotida sp. Indet.						
Golfingia sp. Indet.						
Hirudinea sp. Indet.						
Leptosynapta clarki						
Leptosynapta transgressor						
Nemertinea sp. Indet.		5	3	1	4	13
Nynantheae sp. Indet.			1			1
Ophiura lutkeni						
Ophiura sp. Indet.						
Ophiurida sp. Indet.	5	11	8	9	4	37
Pachycerianthus fimbriata						
Pentamera cf. pseudopopulifera				1		1
Pentamera sp. Indet.						
Pentamera trachyplaca						
Phoronida sp. Indet.						
Phoronis sp. Indet.						
Platyhelminthes sp. Indet.						
Sipunculida sp. Indet.		1		1		2
Solasteridae sp. Indet.						
Thysanocardia nigra						
Turbellaria sp. Indet.						

REPLICATE TMISCAB	5	19	13	17	11
REPLICATE TMISCRC	1	4	4	5	4
STATION TMISCAB	65				
STATION TMISCRC	7				
REPLICATE TABUND	1244	1399	847	1479	1349
REPLICATE TRICH	83	82	84	91	103
STATION TABUND	6318				
STATION TRICH	157				

			EB80			
TAXON	2534-A	2534-B	2534-C	2534-D	2534-E	SppCount
POLYCHAETA						
Amage anops						
Ampharete finmarchica		1				**1**
Ampharete labrops				1		**1**
Ampharete nr. crassiseta				1		**1**
Ampharete sp. Indet./Juv.				2		**2**
Ampharetidae sp. Indet./Juv.				1		**1**
Amphicteis mucronata						
Amphitrite edwardsi						
Amphitrite robusta						
Anobothrus gracilis	1		1		3	**5**
Aphelochaeta monilaris				2	1	**3**
Aphelochaeta sp. 2						
Aphelochaeta sp. Indet.					3	**3**
Aphelochaeta sp. N-1	3	2				**5**
Aphrodita japonica						
Aphrodita sp. Juv.						
Apistobranchus ornatus		3	3			**6**
Aricidea lopezi		3	13	7	7	**30**
Aricidea ramosa						
Armandia brevis						
Artacama coniferi						
Artacamella hancocki						
Asabellides lineata		1				**1**
Asclerocheilus beringianus						
Autolytinae sp. Indet.						
Barantolla americana				3	7	**10**
Barantolla sp. Juv.						
Betapista dekkerae						
Bispira sp. Indet.						
Boccardiella hamata						
Capitella capitata 'hyperspecies'						
Capitellidae sp. Indet./Juv.				1	1	**2**
Caulleriella pacifica						
Chaetopteridae sp. Indet.						
Chaetopterus nr. variopedatus						
Chaetozone acuta						
Chaetozone nr. setosa	3	2	3	1	3	**12**
Chaetozone sp. Indet.		1				**1**
Chone duneri						
Chone sp. Indet.						
Cirratulidae sp. Indet./Juv.	3	3	9	6	3	**24**
Cirratulus sp. Juv.						
Cirratulus spectabilis						
'Clymenura' gracilis			1			**1**
Cossura pygodactylata						
Cossura sp. Indet./Juv.			2			**2**
Diopatra ornata						
Dipolydora akaina						
Dipolydora cardalia	1					**1**
Dipolydora socialis						
Dorvillea pseudorubrovittata						

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB80

	EB80					
TAXON	2534-A	2534-B	2534-C	2534-D	2534-E	SppCount
Dorvillea rudolphi						
Dorvillea sp. Indet.						
Dorvilleidae sp. Indet.						
Drilonereis falcata						
Drilonereis longa						
Ehlersia heterochaeta	2					2
Ehlersia hyperioni	3					3
Epidiopatra hypferiona monroi						
Errano bicirrata						
Eteone sp. Indet.				1	1	2
Euchone incolor	1					1
Euclymeninae sp. Indet./Juv.						
Eulalia californiensis						
Eulalia nr. levicornuta						
Eulalia sp. 1						
Eumida longicornuta	1					1
Eusyllis habei						
Exogone lourei				1		1
Exogone molesta						
Galathowenia oculata						
Gattyana ciliata						
Gattyana cirrosa						
Glycera americana			1			1
Glycera nana	9	7	12	7	6	41
Glycinde armigera	5	2			2	9
Glycinde polygnatha						
Goniada maculata						
Harmothoe fragilis						
Harmothoe imbricata						
Hesionidae sp. Indet./Juv.						
Heteromastus filobranchus			3			3
Idanthyrsus saxicavus						
Isocirrus longiceps	1					1
Lanassa nordenskioldi				6		6
Lanassa sp. Indet.			7		8	15
Lanassa venusta						
Laonice cirrata					1	1
Leitoscoloplos pugettensis	1	1		3		5
Lepidasthenia berkeleyae					1	1
Lepidasthenia longicirrata						
Lepidasthenia sp. Indet./Juv.			1			1
Lepidonotus spiculus						
Levinsenia gracilis	1	5	16	15	4	41
Lumbrineridae sp. Indet./Juv.	4	1	3	9	2	19
Lumbrineris californiensis	3					3
Lumbrineris cruzensis			1			1
Lumbrineris limicola						
Lumbrineris sp. Indet.						
Magelona longicornis	1					1
Magelona sp. Juv.						
Maldane sarsi				1	1	2
Maldanidae sp. Indet./Juv.	2	2	2	2	5	13

	EB80					
TAXON	2534-A	2534-B	2534-C	2534-D	2534-E	SppCount
Maldaninae sp. Indet.						
Malmgreniella bansei						
Malmgreniella berkeleyorum						
Malmgreniella liei						
Malmgreniella sp. Juv.						
Mediomastus ambiseta						
Mediomastus californiensis						
Mediomastus sp. Indet.	1	4	10	10	9	**34**
Megalomma splendida		1			1	**2**
Mesochaetopterus taylori	1					**1**
Metascyhis disparadentata						
Microphthalmus sp. Indet.		2				**2**
Micropodarke dubia						
Monticellina serratiseta	2					**2**
Monticellina sp. A						
Monticellina sp. Indet.						
Myriochele heeri		6	24	11	22	**63**
Myxicola infundibulum						
Neosabellaria cementarium						
Nephtys cornuta	6	11	13	12	3	**45**
Nephtys ferruginea	3	1	3	2	4	**13**
Nephtys sp. Indet./Juv.			1	2	2	**5**
Nereis procera						
Nereis sp. Juv.						
Nereis zonata						
Nicomache personata						
Notocirrus californiensis						
Notomastus latericius						
Notomastus tenuis	4	2		2	3	**11**
Notoproctus pacificus						
Odontosyllis phosphorea						
Oligochaeta sp. Indet.			7	2	1	**10**
Onuphidae sp. Indet./Juv.		2	1	1	3	**7**
Onuphis elegans						
Onuphis iridescens		2	4		1	**7**
Onuphis sp. Juv.						
Ophelina acuminata		1	1	1	2	**5**
Owenia fusiformis						
Paleonotus bellis						
Parandalia fauveli	1					**1**
Paraprionospio pinnata	4	11	8	11	5	**39**
Parougia caeca						
Pectianria californiensis	3	51	37	58	78	**227**
Pectinaria granulata	2				1	**3**
Pectinaria sp. Juv.						
Pherusa plumosa			2			**2**
Pholoe glabra		1	1		3	**5**
Pholoe sp. Indet.						
Pholoides asperus	5					**5**
Phyllochaetopterus prolifica						
Phyllodoce groenlandica			1	1		**2**
Phyllodoce hartmanae					1	**1**

	EB80					
TAXON	2534-A	2534-B	2534-C	2534-D	2534-E	SppCount
Phyllodoce sp. Juv.						
Phyllodoce williamsi						
Phylo felix						
Pilargis maculata	3	4	2	3	1	13
Pionosyllis uraga						
Pista bansei						
Pista brevibranchiata			1			1
Pista elongata						
Pista sp. Juv.						
Platynereis bicanaliculata						
Podarke pugettensis			1			1
Podarkeopsis glabrus				1	1	2
Polycirrus californicus		2		1		3
Polycirrus sp. complex						
Polydora caulleryi		2	3			5
Polydora limicola						
Polydora sp. Indet./Juv.	1					1
Polynoidae sp. Indet.						
Praxillella gracilis						
Praxillella pacifica						
Praxillella sp. Indet.						
Prionospio jubata	27	13	24	14	16	94
Prionospio lighti			4	12		16
Prionospio multibranchiata						
Prionospio sp. Indet.						
Procerea cornuta					1	1
Proclea graffi	3		3	1	6	13
Protodorvillea gracilis						
Pseudopotamilla myriops						
Pseudopotamilla neglecta						
Rhodine bitorquata					1	1
Sabellidae sp. Indet.						
Scalibregma inflatum						
Schistocomus hiltoni						
Scionella japonica						
Scolelepis texana						
Scoletoma luti	4	8	3	4	6	25
Sigambra sp. Juv.		1				1
Sigambra tentaculata			2	2	5	9
Sphaerodoropsis sphaerulifer	6	8	9	6	14	43
Sphaerosyllis ranunculus						
Spio cirrifera						
Spiochaetopterus costarum	18	2	1	2	1	24
Spionidae sp. Indet./Juv.						
Spiophanes berkeleyorum	1					1
Spiophanes bombyx						
Sternaspis scutata						
Sthenalais tertiaglabra			2			2
Streblosoma bairdi						
Streblosoma sp. Juv.						
Syllidae sp. Indet./Juv.						
Tenonia priops		2	2			4

	EB80					
TAXON	2534-A	2534-B	2534-C	2534-D	2534-E	SppCount
Terebellidae sp. Indet./Juv.		9				**9**
Terebellides californica		1			1	**2**
Tharyx sp. Indet.	2					**2**
Thelepus setosus						
Travisia forbesii						
Travisia sp. Juv.						
Trochochaeta multisetosa	5	6	6	3	4	**24**
Typosyllis harti		3			4	**7**

REPLICATE TPOLYAB	**147**	**190**	**254**	**232**	**259**
REPLICATE TPOLYRC	**39**	**40**	**44**	**42**	**47**
STATION TPOLYAB	**1082**				
STATION TPOLYRC	**92**				

MOLLUSCA

Acila castrensis						
Adontorhina cyclia			1			**1**
Aeolidacea sp. 1						
Aeolidacea sp. 2						
Alvania compacta						
Astarte elliptica						
Astyris gausapata		9	7		6	**22**
Axinopsida serricata	132	462	503	445	479	**2021**
Balcis sp. Indet.						
Barleeia sp. Indet.						
Bivalvia sp. Juv.			4	3	2	**9**
Boreotrophon sp. Indet.						
Cardiidae sp. Juv.						
Cardiomya pectinata			1			**1**
Ceratostoma foliatum						
Chaetoderma sp. Indet.	2	3		3		**8**
Chlamys hastata						
Cingula sp. Indet.						
Clinocardium nuttalli						
Clinocardium sp. Juv.						
Compsomyax subdiaphana	2	4	5	2	2	**15**
Crepipatella lingulata						
Cryptonatica affinis				1		**1**
Cyclocardia ventricosa						
Cylichna attonsa						
Delectopecten sp. Juv.						
Delectopecten vancouverensis						
Euspira lewisii						
Galeommatacea sp. Indet.						
Gastropoda sp. Juv.			1			**1**
Gastropteron pacificum	1	3	1	1	1	**7**
Hiatella arctica						
Kurtzia arteaga						
Lirobittium sp. Indet.						
Lucinoma annulatum	5	11	10	4	9	**39**
Lyonsia californica	1		1			**2**
Macoma calcarea					2	**2**

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB80

	EB80					
TAXON	2534-A	2534-B	2534-C	2534-D	2534-E	SppCount
Macoma carlottensis	10	23	175	141	139	**488**
Macoma elimata			1			**1**
Macoma moesta alaskana						
Macoma nasuta						
Macoma obliqua						
Macoma sp. Juv.	55	267	256	254	200	**1032**
Macoma yoldiformis			4		4	**8**
Mactridae sp. Juv.						
Margarites pupillus						
Megacrenella columbiana	1	1	1	2	5	**10**
Musculus discors						
Musculus sp. Juv.						
Mya arenaria						
Mysella tumida				3	2	**5**
Mytilidae sp. Juv.						
Mytilus sp. Juv.						
Nassarius mendicus						
Nemocardium centrifilosum	5	2	5	9	3	**24**
Nucula tenuis	5	4	6	3	2	**20**
Nuculana minuta	1		5		2	**8**
Nuculana sp. Indet.						
Nudibranchia sp. Indet.						
Odostomia sp. Indet.					1	**1**
Pandora filosa		1		1	1	**3**
Pandora sp. Juv.						
Parvilucina tenuisculpta	18	13	25	11	12	**79**
Psephidia lordi						
Retusa sp. Indet.						
Rictaxis punctocaelatus						
Solen sicarius						
Tellina sp. Juv.						
Teredinidae sp. Indet.						
Thracia trapezoides						
Thyasira gouldi	1					**1**
Trichotopis cancellata						
Turbonilla sp. Indet.						
Vitreolina columbiana						
Vitrinella columbiana						
Yoldia scissurata		1	2	4	1	**8**
Yoldia sp. Juv.						

REPLICATE TMOLLAB	**239**	**804**	**1014**	**887**	**873**
REPLICATE TMOLLRC	**14**	**14**	**20**	**16**	**19**
STATION TMOLLAB	**3817**				
STATION TMOLLRC	**27**				

CRUSTACEA

Ampelisca agassizi						
Ampelisca brevisimulata				1	2	**3**
Ampelisca careyi						
Ampelisca hancocki						
Ampelisca lobata						

	EB80					
TAXON	2534-A	2534-B	2534-C	2534-D	2534-E	SppCount
Aoroides intermedia						
Aoroides sp	1					**1**
Araphura sp A						
Balanomorpha						
Byblis millsi						
Campylaspis hartae						
Campylaspis rubromaculata						
Cancer gracilis						
Cancer sp						
Caprella mendax						
Corophium baconi						
Corophium insidiosum	1					**1**
Crangon alaskensis		1				**1**
Crangon sp						
Cyclopoida						
Cyphocaris challengeri						
Deflexilodes enigmaticus						
Desdimelita desdichada						
Desdimelita transmelita						
Diastylis paraspinulosa	1	1	4	3	3	**12**
Diastylis "santamariensis"	1					**1**
Discorsopagurus schmitti						
Dyopedos monacanthus						
Eobrolgus chumashi						
Eochelidium sp A						
Ericthonius brasiliensis						
Ericthonius rubricornis						
Eualus sp						
Eudorella pacifica	2	10	21	28	1	**62**
Eudorellopsis longirostris	1	1	4	2	1	**9**
Euphilomedes carcharodonta	79	67	73	61	51	**331**
Euphilomedes producta	30	96	109	149	91	**475**
Euphilomedes sp						
Eusirus columbianus						
Eyakia robustus						
Haliophasma geminatum				1	1	**2**
Heptacarpus brevirostris						
Heterophoxus conlanae	1					**1**
Heterophoxus sp						
Hippolytidae	3					**3**
Hippomedon sp A		1			1	**2**
Leptochelia dubia						
Leptognathia gracilis		1		2	1	**4**
Leptognathia sp E						
Leucon sp A						
Limnoria lignorum						
Lophopanopeus sp						
Majidae						
Mayerella banksia		1			1	**2**
Melphisana "bola"						
Mesocrangon munitella						
Metacaprella anomala			1			**1**

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB80

	EB80					
TAXON	2534-A	2534-B	2534-C	2534-D	2534-E	SppCount
Metaphoxus frequens		2	1	4	3	10
Microjassa litotes						
Munna fernaldi						
Munnogonium tillerae						
Mysidae						
Mysidella americana						
Nebalia "pugettensis"						
Neotrypaea sp						
Orchomene decipiens						
Orchomene pacifica					1	1
Orchomene pinguis						
Oregonia gracilis						
Pachynus barnardi						
Pagurus sp						
Parametaphoxus quaylei						
Parasterope barnesi						
Pardalisca tenuipes						
Photis brevipes						
Photis macrotica						
Photis sp						
Pinnixa occidentalis						
Pinnixa schmitti						
Pinnixa sp	1					1
Pinnotheridae						
Pleurogonium californiense						
Pleurogonium rubicundum	1					1
Pleusymtes sp A		1				1
Prachynella lodo						
Protomedeia prudens				1		1
Protomedeia sp						
Rutiderma lomae	6	5	9	13	7	40
Scoloura phillipsi						
Solidobalanus hesperius						
Spirontocaris sp						
Synchelidium pectinatum						
Synchelidium rectipalmum						
Synchelidium sp						
Upogebia pugettensis		2	1		1	4
Westwoodilla caecula	1	1			1	3

REPLICATE TCRSTAB	**129**	**190**	**223**	**265**	**166**
REPLICATE TCRSTRC	**14**	**14**	**9**	**11**	**15**
STATION TCRSTAB	**973**				
STATION TCRSTRC	**26**				

MISCELLANEOUS

Amphiodia periercta	4		2	1	1	8
Amphiodia sp. Indet.		4		10		14
Amphipholis sp. Indet.						
Amphipholis squamata						
Amphiuridae sp. Indet.						
Anthozoa sp. Indet.						

			EB80			
TAXON	2534-A	2534-B	2534-C	2534-D	2534-E	SppCount
Arhynchite pugettensis				2		2
Asteroidea sp. Juv.						
Brachiopoda sp. Indet.						
Chiridota sp. Indet.						
Cucumaria piperata						
Cucumaria sp. Indet.						
Dendrochirotida sp. Indet.						
Golfingia sp. Indet.						
Hirudinea sp. Indet.						
Leptosynapta clarki						
Leptosynapta transgressor						
Nemertinea sp. Indet.		5	2	2	4	13
Nynantheae sp. Indet.	2			2		4
Ophiura lutkeni				2		2
Ophiura sp. Indet.						
Ophiurida sp. Indet.	23	4	1	2	8	38
Pachycerianthus fimbriata						
Pentamera cf. pseudopopulifera	1			1		2
Pentamera sp. Indet.				3		3
Pentamera trachyplaca						
Phoronida sp. Indet.						
Phoronis sp. Indet.						
Platyhelminthes sp. Indet.						
Sipunculida sp. Indet.	1	2	1			4
Solasteridae sp. Indet.						
Thysanocardia nigra						
Turbellaria sp. Indet.						

REPLICATE TMISCAB	**31**	**15**	**6**	**25**	**13**
REPLICATE TMISCRC	**5**	**4**	**4**	**9**	**3**
STATION TMISCAB	**90**				
STATION TMISCRC	**10**				
REPLICATE TABUND	**546**	**1199**	**1497**	**1409**	**1311**
REPLICATE TRICH	**72**	**72**	**77**	**78**	**84**
STATION TABUND	**5962**				
STATION TRICH	**155**				

	EB85					
TAXON	2535-A	2535-B	2535-C	2535-D	2535-E	SppCount
POLYCHAETA						
Amage anops						
Ampharete finmarchica		2	1	1		**4**
Ampharete labrops						
Ampharete nr. crassiseta				1	1	**2**
Ampharete sp. Indet./Juv.						
Ampharetidae sp. Indet./Juv.						
Amphicteis mucronata						
Amphitrite edwardsi				1		**1**
Amphitrite robusta						
Anobothrus gracilis	3	6		3	5	**17**
Aphelochaeta monilaris				2	1	**3**
Aphelochaeta sp. 2						
Aphelochaeta sp. Indet.	2				1	**3**
Aphelochaeta sp. N-1				1		**1**
Aphrodita japonica						
Aphrodita sp. Juv.						
Apistobranchus ornatus						
Aricidea lopezi	1	3		1	3	**8**
Aricidea ramosa						
Armandia brevis						
Artacama coniferi	1	1				**2**
Artacamella hancocki						
Asabellides lineata						
Asclerocheilus beringianus						
Autolytinae sp. Indet.						
Barantolla americana		4		2	2	**8**
Barantolla sp. Juv.						
Betapista dekkerae						
Bispira sp. Indet.						
Boccardiella hamata						
Capitella capitata 'hyperspecies'						
Capitellidae sp. Indet./Juv.			1		1	**2**
Caulleriella pacifica			1			**1**
Chaetopteridae sp. Indet.						
Chaetopterus nr. variopedatus						
Chaetozone acuta	2					**2**
Chaetozone nr. setosa	7	7	3	5	4	**26**
Chaetozone sp. Indet.						
Chone duneri						
Chone sp. Indet.						
Cirratulidae sp. Indet./Juv.		4	1	2	7	**14**
Cirratulus sp. Juv.						
Cirratulus spectabilis						
'Clymenura' gracilis	5	5	3	1	11	**25**
Cossura pygodactylata						
Cossura sp. Indet./Juv.					1	**1**
Diopatra ornata	1		1		1	**3**
Dipolydora akaina						
Dipolydora cardalia		1				**1**
Dipolydora socialis		1	1		1	**3**
Dorvillea pseudorubrovittata						

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB85

	EB85					
TAXON	2535-A	2535-B	2535-C	2535-D	2535-E	SppCount
Dorvillea rudolphi						
Dorvillea sp. Indet.						
Dorvilleidae sp. Indet.						
Drilonereis falcata						
Drilonereis longa						
Ehlersia heterochaeta		1				1
Ehlersia hyperioni		1				1
Epidiopatra hypferiona monroi		2			1	3
Errano bicirrata						
Eteone sp. Indet.		9		1	1	11
Euchone incolor						
Euclymeninae sp. Indet./Juv.						
Eulalia californiensis						
Eulalia nr. levicornuta						
Eulalia sp. 1						
Eumida longicornuta	1	3	2	2	2	10
Eusyllis habei						
Exogone lourei	1	4	1	3	2	11
Exogone molesta						
Galathowenia oculata				1		1
Gattyana ciliata						
Gattyana cirrosa						
Glycera americana					1	1
Glycera nana	6	6	5	11	8	36
Glycinde armigera		1		2		3
Glycinde polygnatha				1	1	2
Goniada maculata						
Harmothoe fragilis						
Harmothoe imbricata						
Hesionidae sp. Indet./Juv.						
Heteromastus filobranchus				1		1
Idanthyrsus saxicavus						
Isocirrus longiceps						
Lanassa nordenskioldi		14	7	7	12	40
Lanassa sp. Indet.						
Lanassa venusta	11					11
Laonice cirrata		1		1		2
Leitoscoloplos pugettensis	2	2	2	1	1	8
Lepidasthenia berkeleyae						
Lepidasthenia longicirrata						
Lepidasthenia sp. Indet./Juv.				1		1
Lepidonotus spiculus						
Levinsenia gracilis		4		2	1	7
Lumbrineridae sp. Indet./Juv.				3	2	5
Lumbrineris californiensis						
Lumbrineris cruzensis				1		1
Lumbrineris limicola						
Lumbrineris sp. Indet.						
Magelona longicornis		1				1
Magelona sp. Juv.						
Maldane sarsi						
Maldanidae sp. Indet./Juv.	4	3	2		4	13

	EB85					
TAXON	2535-A	2535-B	2535-C	2535-D	2535-E	**SppCount**
Maldaninae sp. Indet.						
Malmgreniella bansei						
Malmgreniella berkeleyorum						
Malmgreniella liei					1	**1**
Malmgreniella sp. Juv.						
Mediomastus ambiseta						
Mediomastus californiensis						
Mediomastus sp. Indet.	5	3	1	4	3	**16**
Megalomma splendida			1	1	1	**3**
Mesochaetopterus taylori						
Metascyhis disparadentata						
Microphthalmus sp. Indet.		1			2	**3**
Micropodarke dubia						
Monticellina serratiseta			4	1	2	**7**
Monticellina sp. A						
Monticellina sp. Indet.						
Myriochele heeri	12	14	21	7	14	**68**
Myxicola infundibulum						
Neosabellaria cementarium						
Nephtys cornuta	3	9	5	1	5	**23**
Nephtys ferruginea	6	15	6	4	5	**36**
Nephtys sp. Indet./Juv.		8		4	9	**21**
Nereis procera						
Nereis sp. Juv.						
Nereis zonata						
Nicomache personata						
Notocirrus californiensis						
Notomastus latericius						
Notomastus tenuis	11	10	6	3	3	**33**
Notoproctus pacificus						
Odontosyllis phosphorea						
Oligochaeta sp. Indet.		3				**3**
Onuphidae sp. Indet./Juv.	1	2	2		3	**8**
Onuphis elegans						
Onuphis iridescens	3	3	1	5	2	**14**
Onuphis sp. Juv.						
Ophelina acuminata				1	2	**3**
Owenia fusiformis						
Paleonotus bellis						
Parandalia fauveli		1				**1**
Paraprionospio pinnata	5	15	5	4	9	**38**
Parougia caeca						
Pectianria californiensis	46	65	46	60	58	**275**
Pectinaria granulata		1		1	3	**5**
Pectinaria sp. Juv.						
Pherusa plumosa						
Pholoe glabra	1			3		**4**
Pholoe sp. Indet.				1		**1**
Pholoides asperus						
Phyllochaetopterus prolifica						
Phyllodoce groenlandica		2				**2**
Phyllodoce hartmanae				1		**1**

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB85

TAXON	EB85 2535-A	2535-B	2535-C	2535-D	2535-E	SppCount
Phyllodoce sp. Juv.						
Phyllodoce williamsi						
Phylo felix	1				1	2
Pilargis maculata				7	3	10
Pionosyllis uraga						
Pista bansei						
Pista brevibranchiata						
Pista elongata						
Pista sp. Juv.						
Platynereis bicanaliculata						
Podarke pugettensis						
Podarkeopsis glabrus			1	4	1	6
Polycirrus californicus	2	3	3	4	10	22
Polycirrus sp. complex					1	1
Polydora caulleryi					2	2
Polydora limicola						
Polydora sp. Indet./Juv.						
Polynoidae sp. Indet.						
Praxillella gracilis						
Praxillella pacifica						
Praxillella sp. Indet.						
Prionospio jubata	22	39	13	35	37	146
Prionospio lighti		3				3
Prionospio multibranchiata						
Prionospio sp. Indet.						
Procerea cornuta						
Proclea graffi	2	9		2	3	16
Protodorvillea gracilis						
Pseudopotamilla myriops						
Pseudopotamilla neglecta						
Rhodine bitorquata	1	1	1	1		4
Sabellidae sp. Indet.						
Scalibregma inflatum						
Schistocomus hiltoni						
Scionella japonica						
Scolelepis texana						
Scoletoma luti	11	16	1	6	5	39
Sigambra sp. Juv.						
Sigambra tentaculata					1	1
Sphaerodoropsis sphaerulifer	11	17	11	10	10	59
Sphaerosyllis ranunculus						
Spio cirrifera						
Spiochaetopterus costarum	2	12	3	5	7	29
Spionidae sp. Indet./Juv.						
Spiophanes berkeleyorum						
Spiophanes bombyx						
Sternaspis scutata						
Sthenalais tertiaglabra	2		1			3
Streblosoma bairdi						
Streblosoma sp. Juv.		1				1
Syllidae sp. Indet./Juv.						
Tenonia priops	2		1	1	1	5

	EB85					
TAXON	2535-A	2535-B	2535-C	2535-D	2535-E	**SppCount**
Terebellidae sp. Indet./Juv.					1	**1**
Terebellides californica						
Tharyx sp. Indet.						
Thelepus setosus						
Travisia forbesii						
Travisia sp. Juv.						
Trochochaeta multisetosa		1		4	1	**6**
Typosyllis harti		1	1			**2**

REPLICATE TPOLYAB	**196**	**341**	**165**	**238**	**281**
REPLICATE TPOLYRC	**34**	**50**	**35**	**53**	**56**
STATION TPOLYAB	**1221**				
STATION TPOLYRC	**84**				

MOLLUSCA

Acila castrensis						
Adontorhina cyclia						
Aeolidacea sp. 1						
Aeolidacea sp. 2						
Alvania compacta		1				**1**
Astarte elliptica						
Astyris gausapata	8			2	1	**11**
Axinopsida serricata	383	501	270	368	404	**1926**
Balcis sp. Indet.						
Barleeia sp. Indet.						
Bivalvia sp. Juv.		2		2		**4**
Boreotrophon sp. Indet.						
Cardiidae sp. Juv.						
Cardiomya pectinata		1				**1**
Ceratostoma foliatum						
Chaetoderma sp. Indet.			3	2	1	**6**
Chlamys hastata						
Cingula sp. Indet.						
Clinocardium nuttalli						
Clinocardium sp. Juv.						
Compsomyax subdiaphana	5	6	5	6	4	**26**
Crepipatella lingulata						
Cryptonatica affinis						
Cyclocardia ventricosa						
Cylichna attonsa						
Delectopecten sp. Juv.						
Delectopecten vancouverensis						
Euspira lewisii						
Galeommatacea sp. Indet.						
Gastropoda sp. Juv.						
Gastropteron pacificum	1		1		1	**3**
Hiatella arctica				1		**1**
Kurtzia arteaga						
Lirobittium sp. Indet.						
Lucinoma annulatum	6	10	7	12	8	**43**
Lyonsia californica	1	1		2	1	**5**
Macoma calcarea						

TAXON	2535-A	2535-B	2535-C	2535-D	2535-E	SppCount
				EB85		
Macoma carlottensis	103	89	71	270	70	603
Macoma elimata	3	7	5	4	1	20
Macoma moesta alaskana						
Macoma nasuta						
Macoma obliqua						
Macoma sp. Juv.	300	423	134	274	380	1511
Macoma yoldiformis			3	5	1	9
Mactridae sp. Juv.						
Margarites pupillus						
Megacrenella columbiana	9	8	8	11	15	51
Musculus discors						
Musculus sp. Juv.						
Mya arenaria		1				1
Mysella tumida		3		2	3	8
Mytilidae sp. Juv.						
Mytilus sp. Juv.						
Nassarius mendicus						
Nemocardium centrifilosum	3	11	3	2	4	23
Nucula tenuis	10	13	5	16	16	60
Nuculana minuta	8	10	6	10	7	41
Nuculana sp. Indet.						
Nudibranchia sp. Indet.						
Odostomia sp. Indet.	1			2		3
Pandora filosa	2		1			3
Pandora sp. Juv.						
Parvilucina tenuisculpta	27	25	25	23	22	122
Psephidia lordi						
Retusa sp. Indet.						
Rictaxis punctocaelatus						
Solen sicarius						
Tellina sp. Juv.						
Teredinidae sp. Indet.						
Thracia trapezoides						
Thyasira gouldi		1	1			2
Trichotopis cancellata						
Turbonilla sp. Indet.	1	1	1			3
Vitreolina columbiana						
Vitrinella columbiana						
Yoldia scissurata	4	1	1	5	3	14
Yoldia sp. Juv.					2	2

REPLICATE TMOLLAB	875	1115	550	1019	944
REPLICATE TMOLLRC	18	20	18	20	19
STATION TMOLLAB	4503				
STATION TMOLLRC	28				

CRUSTACEA

Ampelisca agassizi						
Ampelisca brevisimulata						
Ampelisca careyi						
Ampelisca hancocki						
Ampelisca lobata						

	EB85					
TAXON	2535-A	2535-B	2535-C	2535-D	2535-E	**SppCount**
Aoroides intermedia						
Aoroides sp						
Araphura sp A					1	**1**
Balanomorpha		1			4	**5**
Byblis millsi	1	1				**2**
Campylaspis hartae						
Campylaspis rubromaculata						
Cancer gracilis						
Cancer sp						
Caprella mendax				3		**3**
Corophium baconi						
Corophium insidiosum						
Crangon alaskensis						
Crangon sp						
Cyclopoida						
Cyphocaris challengeri						
Deflexilodes enigmaticus						
Desdimelita desdichada						
Desdimelita transmelita						
Diastylis paraspinulosa	1	3	2	1		**7**
Diastylis "santamariensis"						
Discorsopagurus schmitti						
Dyopedos monacanthus		1				**1**
Eobrolgus chumashi						
Eochelidium sp A						
Ericthonius brasiliensis						
Ericthonius rubricornis						
Eualus sp						
Eudorella pacifica	10	11	2	19	23	**65**
Eudorellopsis longirostris	2	4	1	2	2	**11**
Euphilomedes carcharodonta	120	132	114	100	97	**563**
Euphilomedes producta	125	160	116	130	138	**669**
Euphilomedes sp						
Eusirus columbianus						
Eyakia robustus						
Haliophasma geminatum	1	1		1	3	**6**
Heptacarpus brevirostris						
Heterophoxus conlanae		1				**1**
Heterophoxus sp						
Hippolytidae						
Hippomedon sp A	9	2	1	2	1	**15**
Leptochelia dubia						
Leptognathia gracilis					1	**1**
Leptognathia sp E		1				**1**
Leucon sp A	1					**1**
Limnoria lignorum						
Lophopanopeus sp						
Majidae						
Mayerella banksia		1				**1**
Melphisana "bola"						
Mesocrangon munitella						
Metacaprella anomala						

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB85

TAXON	EB85 2535-A	2535-B	2535-C	2535-D	2535-E	SppCount
Metaphoxus frequens	1	1	1	1	2	6
Microjassa litotes						
Munna fernaldi						
Munnogonium tillerae						
Mysidae						
Mysidella americana						
Nebalia "pugettensis"	1	1		2		4
Neotrypaea sp		1			1	2
Orchomene decipiens						
Orchomene pacifica				1		1
Orchomene pinguis						
Oregonia gracilis						
Pachynus barnardi						
Pagurus sp						
Parametaphoxus quaylei						
Parasterope barnesi	1	1		5	2	9
Pardalisca tenuipes						
Photis brevipes						
Photis macrotica						
Photis sp		1				1
Pinnixa occidentalis						
Pinnixa schmitti		1				1
Pinnixa sp		3	2		5	10
Pinnotheridae						
Pleurogonium californiense						
Pleurogonium rubicundum						
Pleusymtes sp A						
Prachynella lodo		1				1
Protomedeia prudens						
Protomedeia sp						
Rutiderma lomae	8	46	6	31	26	117
Scoloura phillipsi		1				1
Solidobalanus hesperius				4	3	7
Spirontocaris sp						
Synchelidium pectinatum	3		1		1	5
Synchelidium rectipalmum		1				1
Synchelidium sp						
Upogebia pugettensis		1	1			2
Westwoodilla caecula	3			1	2	6

REPLICATE TCRSTAB	**287**	**378**	**247**	**303**	**312**
REPLICATE TCRSTRC	**15**	**25**	**11**	**15**	**17**
STATION TCRSTAB	**1527**				
STATION TCRSTRC	**33**				

MISCELLANEOUS

Amphiodia periercta	5			3		8
Amphiodia sp. Indet.	3	1	4	5	1	14
Amphipholis sp. Indet.						
Amphipholis squamata						
Amphiuridae sp. Indet.						
Anthozoa sp. Indet.						

	EB85					
TAXON	2535-A	2535-B	2535-C	2535-D	2535-E	SppCount
Arhynchite pugettensis						
Asteroidea sp. Juv.						
Brachiopoda sp. Indet.						
Chiridota sp. Indet.						
Cucumaria piperata						
Cucumaria sp. Indet.						
Dendrochirotida sp. Indet.						
Golfingia sp. Indet.						
Hirudinea sp. Indet.						
Leptosynapta clarki						
Leptosynapta transgressor						
Nemertinea sp. Indet.	7	5	4	2	5	**23**
Nynantheae sp. Indet.						
Ophiura lutkeni						
Ophiura sp. Indet.						
Ophiurida sp. Indet.	8	5	5	12	2	**32**
Pachycerianthus fimbriata						
Pentamera cf. pseudopopulifera		2				**2**
Pentamera sp. Indet.						
Pentamera trachyplaca						
Phoronida sp. Indet.						
Phoronis sp. Indet.						
Platyhelminthes sp. Indet.					1	**1**
Sipunculida sp. Indet.		1	2	3	1	**7**
Solasteridae sp. Indet.						
Thysanocardia nigra						
Turbellaria sp. Indet.						

REPLICATE TMISCAB	**23**	**14**	**15**	**25**	**10**
REPLICATE TMISCRC	**4**	**5**	**4**	**5**	**5**
STATION TMISCAB	**87**				
STATION TMISCRC	**7**				
REPLICATE TABUND	**1381**	**1848**	**977**	**1585**	**1547**
REPLICATE TRICH	**71**	**100**	**68**	**93**	**97**
STATION TABUND	**7338**				
STATION TRICH	**152**				

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB87

	EB87					
TAXON	2537-A	2537-B	2537-C	2537-D	2537-E	SppCount
POLYCHAETA						
Amage anops						
Ampharete finmarchica	1			1		2
Ampharete labrops						
Ampharete nr. crassiseta						
Ampharete sp. Indet./Juv.				1		1
Ampharetidae sp. Indet./Juv.						
Amphicteis mucronata						
Amphitrite edwardsi						
Amphitrite robusta						
Anobothrus gracilis	11	5	7	2	5	30
Aphelochaeta monilaris	2	1	1	3		7
Aphelochaeta sp. 2						
Aphelochaeta sp. Indet.	2	13	15	5	20	55
Aphelochaeta sp. N-1	4	2	6	12	12	36
Aphrodita japonica						
Aphrodita sp. Juv.						
Apistobranchus ornatus						
Aricidea lopezi					1	1
Aricidea ramosa						
Armandia brevis		1				1
Artacama coniferi			1			1
Artacamella hancocki						
Asabellides lineata						
Asclerocheilus beringianus						
Autolytinae sp. Indet.						
Barantolla americana	2					2
Barantolla sp. Juv.						
Betapista dekkerae						
Bispira sp. Indet.					1	1
Boccardiella hamata						
Capitella capitata 'hyperspecies'			2			2
Capitellidae sp. Indet./Juv.			2		1	3
Caulleriella pacifica	2	1	6	3	8	20
Chaetopteridae sp. Indet.						
Chaetopterus nr. variopedatus						
Chaetozone acuta		1	3	2	2	8
Chaetozone nr. setosa	11	4	6	10	5	36
Chaetozone sp. Indet.						
Chone duneri						
Chone sp. Indet.						
Cirratulidae sp. Indet./Juv.	7	17	5	5	6	40
Cirratulus sp. Juv.		2		1		3
Cirratulus spectabilis				1	1	2
'Clymenura' gracilis	3	1	1	1	3	9
Cossura pygodactylata		1				1
Cossura sp. Indet./Juv.	2	1	7	1	3	14
Diopatra ornata	1	3	3	3	5	15
Dipolydora akaina	1					1
Dipolydora cardalia	3	1	1	1		6
Dipolydora socialis						
Dorvillea pseudorubrovittata						

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB87

	EB87					
TAXON	2537-A	2537-B	2537-C	2537-D	2537-E	SppCount
Dorvillea rudolphi	1					1
Dorvillea sp. Indet.						
Dorvilleidae sp. Indet.		1				1
Drilonereis falcata						
Drilonereis longa			1			1
Ehlersia heterochaeta	2	2	2	2	2	10
Ehlersia hyperioni	9	8	12	12	19	60
Epidiopatra hypferiona monroi		1				1
Errano bicirrata						
Eteone sp. Indet.	2	5	2		1	10
Euchone incolor	1		1		1	3
Euclymeninae sp. Indet./Juv.	1					1
Eulalia californiensis	2		3		3	8
Eulalia nr. levicornuta						
Eulalia sp. 1						
Eumida longicornuta	15	9	20	19	17	80
Eusyllis habei					1	1
Exogone lourei	3		2	4	3	12
Exogone molesta			2		1	3
Galathowenia oculata						
Gattyana ciliata				1		1
Gattyana cirrosa		1		1		2
Glycera americana						
Glycera nana	10	9	7	8	10	44
Glycinde armigera	2	1	2	1	2	8
Glycinde polygnatha	1					1
Goniada maculata						
Harmothoe fragilis						
Harmothoe imbricata						
Hesionidae sp. Indet./Juv.					3	3
Heteromastus filobranchus	7					7
Idanthyrsus saxicavus						
Isocirrus longiceps			1			1
Lanassa nordenskioldi						
Lanassa sp. Indet.						
Lanassa venusta		1		1		2
Laonice cirrata		3	4	1		8
Leitoscoloplos pugettensis		1	1	2		4
Lepidasthenia berkeleyae						
Lepidasthenia longicirrata						
Lepidasthenia sp. Indet./Juv.						
Lepidonotus spiculus			2	1	3	6
Levinsenia gracilis	1	9	1	4	2	17
Lumbrineridae sp. Indet./Juv.	19	12	27	3	15	76
Lumbrineris californiensis	26	47	36	56	54	219
Lumbrineris cruzensis		4				4
Lumbrineris limicola						
Lumbrineris sp. Indet.				4		4
Magelona longicornis	8	2	2	3	3	18
Magelona sp. Juv.						
Maldane sarsi						
Maldanidae sp. Indet./Juv.					1	1

	EB87					
TAXON	2537-A	2537-B	2537-C	2537-D	2537-E	SppCount
Maldaninae sp. Indet.						
Malmgreniella bansei						
Malmgreniella berkeleyorum						
Malmgreniella liei						
Malmgreniella sp. Juv.						
Mediomastus ambiseta						
Mediomastus californiensis						
Mediomastus sp. Indet.	14	12	24	18	21	**89**
Megalomma splendida						
Mesochaetopterus taylori	7	6	6	6	3	**28**
Metascyhis disparadentata						
Microphthalmus sp. Indet.	8	11	5	1	8	**33**
Micropodarke dubia						
Monticellina serratiseta	1	1				**2**
Monticellina sp. A						
Monticellina sp. Indet.					5	**5**
Myriochele heeri						
Myxicola infundibulum		1				**1**
Neosabellaria cementarium						
Nephtys cornuta	6	5	20	20	21	**72**
Nephtys ferruginea	8	12	19	13	9	**61**
Nephtys sp. Indet./Juv.	3	8	6	4	4	**25**
Nereis procera	1	1	3	3	2	**10**
Nereis sp. Juv.						
Nereis zonata					1	**1**
Nicomache personata						
Notocirrus californiensis						
Notomastus latericius						
Notomastus tenuis	18	16	13	20	20	**87**
Notoproctus pacificus						
Odontosyllis phosphorea						
Oligochaeta sp. Indet.			1		1	**2**
Onuphidae sp. Indet./Juv.		1				**1**
Onuphis elegans	1					**1**
Onuphis iridescens	2					**2**
Onuphis sp. Juv.						
Ophelina acuminata			1			**1**
Owenia fusiformis						
Paleonotus bellis						
Parandalia fauveli	12	3	3	1	5	**24**
Paraprionospio pinnata	28	18	23	13	22	**104**
Parougia caeca					1	**1**
Pectianria californiensis	12	3	15	17	8	**55**
Pectinaria granulata	10	4		7		**21**
Pectinaria sp. Juv.						
Pherusa plumosa						
Pholoe glabra	2	1	1		1	**5**
Pholoe sp. Indet.						
Pholoides asperus	12	1	1	6	9	**29**
Phyllochaetopterus prolifica						
Phyllodoce groenlandica			1	2	1	**4**
Phyllodoce hartmanae	2		3	1		**6**

	EB87					
TAXON	2537-A	2537-B	2537-C	2537-D	2537-E	SppCount
Phyllodoce sp. Juv.			1		1	2
Phyllodoce williamsi		1				1
Phylo felix						
Pilargis maculata		1		2	4	7
Pionosyllis uraga						
Pista bansei		1			1	2
Pista brevibranchiata						
Pista elongata						
Pista sp. Juv.						
Platynereis bicanaliculata					1	1
Podarke pugettensis			5		3	8
Podarkeopsis glabrus	5	1	1	4	6	17
Polycirrus californicus	1	1				2
Polycirrus sp. complex						
Polydora caulleryi	3	2			1	6
Polydora limicola	1	1				2
Polydora sp. Indet./Juv.	1					1
Polynoidae sp. Indet.	1					1
Praxillella gracilis	1					1
Praxillella pacifica						
Praxillella sp. Indet.						
Prionospio jubata	57	85	185	142	141	610
Prionospio lighti	5	2	30	14	10	61
Prionospio multibranchiata			1			1
Prionospio sp. Indet.					2	2
Procerea cornuta	2			2		4
Proclea graffi	2					2
Protodorvillea gracilis	1					1
Pseudopotamilla myriops	1				1	2
Pseudopotamilla neglecta						
Rhodine bitorquata		1				1
Sabellidae sp. Indet.					3	3
Scalibregma inflatum						
Schistocomus hiltoni						
Scionella japonica						
Scolelepis texana						
Scoletoma luti	34	6	6	1	3	50
Sigambra sp. Juv.						
Sigambra tentaculata	1				1	2
Sphaerodoropsis sphaerulifer	1	2	2	2	1	8
Sphaerosyllis ranunculus						
Spio cirrifera			1			1
Spiochaetopterus costarum	202	150	189	128	145	814
Spionidae sp. Indet./Juv.						
Spiophanes berkeleyorum	5	1	2	4	1	13
Spiophanes bombyx						
Sternaspis scutata						
Sthenalais tertiaglabra	1			1		2
Streblosoma bairdi				1		1
Streblosoma sp. Juv.						
Syllidae sp. Indet./Juv.			1		1	2
Tenonia priops	1				1	2

	EB87					
TAXON	2537-A	2537-B	2537-C	2537-D	2537-E	SppCount
Terebellidae sp. Indet./Juv.						
Terebellides californica						
Tharyx sp. Indet.						
Thelepus setosus						
Travisia forbesii						
Travisia sp. Juv.						
Trochochaeta multisetosa	4		2	2	3	**11**
Typosyllis harti	19	8	1	5	8	**41**

REPLICATE TPOLYAB	**658**	**537**	**766**	**615**	**694**
REPLICATE TPOLYRC	**71**	**64**	**65**	**61**	**71**
STATION TPOLYAB	**3270**				
STATION TPOLYRC	**119**				

MOLLUSCA

Acila castrensis						
Adontorhina cyclia						
Aeolidacea sp. 1						
Aeolidacea sp. 2						
Alvania compacta			1		1	**2**
Astarte elliptica						
Astyris gausapata	4	1	8	21	4	**38**
Axinopsida serricata	116	92	94	116	109	**527**
Balcis sp. Indet.	1			2	2	**5**
Barleeia sp. Indet.						
Bivalvia sp. Juv.	3		1	2	2	**8**
Boreotrophon sp. Indet.						
Cardiidae sp. Juv.						
Cardiomya pectinata						
Ceratostoma foliatum						
Chaetoderma sp. Indet.	1				2	**3**
Chlamys hastata						
Cingula sp. Indet.						
Clinocardium nuttalli						
Clinocardium sp. Juv.						
Compsomyax subdiaphana	1					**1**
Crepipatella lingulata						
Cryptonatica affinis						
Cyclocardia ventricosa						
Cylichna attonsa						
Delectopecten sp. Juv.						
Delectopecten vancouverensis						
Euspira lewisii						
Galeommatacea sp. Indet.						
Gastropoda sp. Juv.						
Gastropteron pacificum	1			1	1	**3**
Hiatella arctica	1					**1**
Kurtzia arteaga			1			**1**
Lirobittium sp. Indet.						
Lucinoma annulatum	4	5		3	2	**14**
Lyonsia californica	6	2	2	1	1	**12**
Macoma calcarea		1				**1**

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB87

	EB87					
TAXON	2537-A	2537-B	2537-C	2537-D	2537-E	SppCount
Macoma carlottensis	4	9	2	7	1	23
Macoma elimata	3		2			5
Macoma moesta alaskana						
Macoma nasuta						
Macoma obliqua						
Macoma sp. Juv.	30	10	4	10	17	71
Macoma yoldiformis	2	7	2	4		15
Mactridae sp. Juv.						
Margarites pupillus						
Megacrenella columbiana	3	2	3	3	2	13
Musculus discors						
Musculus sp. Juv.		1				1
Mya arenaria			1	2	2	5
Mysella tumida	4	4	12	1	5	26
Mytilidae sp. Juv.		1	1			2
Mytilus sp. Juv.						
Nassarius mendicus						
Nemocardium centrifilosum	1	3		1		5
Nucula tenuis			1	2	1	4
Nuculana minuta						
Nuculana sp. Indet.						
Nudibranchia sp. Indet.						
Odostomia sp. Indet.		1		1		2
Pandora filosa		2				2
Pandora sp. Juv.						
Parvilucina tenuisculpta	137	122	98	122	121	600
Psephidia lordi	1			1		2
Retusa sp. Indet.			1			1
Rictaxis punctocaelatus	1					1
Solen sicarius						
Tellina sp. Juv.						
Teredinidae sp. Indet.					1	1
Thracia trapezoides						
Thyasira gouldi	1			3	2	6
Trichotopis cancellata						
Turbonilla sp. Indet.			2	2		4
Vitreolina columbiana						
Vitrinella columbiana						
Yoldia scissurata						
Yoldia sp. Juv.						

REPLICATE TMOLLAB	**325**	**263**	**236**	**305**	**276**
REPLICATE TMOLLRC	**21**	**16**	**18**	**20**	**18**
STATION TMOLLAB	**1405**				
STATION TMOLLRC	**33**				

CRUSTACEA

Ampelisca agassizi						
Ampelisca brevisimulata						
Ampelisca careyi						
Ampelisca hancocki						
Ampelisca lobata				1	1	2

			EB87			
TAXON	2537-A	2537-B	2537-C	2537-D	2537-E	SppCount
Aoroides intermedia		1	3	1	3	**8**
Aoroides sp						
Araphura sp A						
Balanomorpha						
Byblis millsi	1	2	6	1	2	**12**
Campylaspis hartae						
Campylaspis rubromaculata						
Cancer gracilis		1	2	1	1	**5**
Cancer sp						
Caprella mendax				1	1	**2**
Corophium baconi						
Corophium insidiosum						
Crangon alaskensis			1	2		**3**
Crangon sp						
Cyclopoida						
Cyphocaris challengeri						
Deflexilodes enigmaticus			1	1	1	**3**
Desdimelita desdichada					1	**1**
Desdimelita transmelita						
Diastylis paraspinulosa	1					**1**
Diastylis "santamariensis"		2			1	**3**
Discorsopagurus schmitti						
Dyopedos monacanthus	2					**2**
Eobrolgus chumashi				1	2	**3**
Eochelidium sp A						
Ericthonius brasiliensis		1				**1**
Ericthonius rubricornis						
Eualus sp			2			**2**
Eudorella pacifica	7	2	13	8	12	**42**
Eudorellopsis longirostris					1	**1**
Euphilomedes carcharodonta	101	121	215	161	172	**770**
Euphilomedes producta	19	15	21	26	27	**108**
Euphilomedes sp						
Eusirus columbianus						
Eyakia robustus						
Haliophasma geminatum	1					**1**
Heptacarpus brevirostris						
Heterophoxus conlanae	4	8	6	11	11	**40**
Heterophoxus sp						
Hippolytidae					1	**1**
Hippomedon sp A						
Leptochelia dubia			1	4		**5**
Leptognathia gracilis						
Leptognathia sp E						
Leucon sp A	1			1		**2**
Limnoria lignorum						
Lophopanopeus sp					1	**1**
Majidae			1			**1**
Mayerella banksia		1	3			**4**
Melphisana "bola"						
Mesocrangon munitella					2	**2**
Metacaprella anomala						

	EB87					
TAXON	2537-A	2537-B	2537-C	2537-D	2537-E	SppCount
Metaphoxus frequens						
Microjassa litotes						
Munna fernaldi						
Munnogonium tillerae						
Mysidae		1				1
Mysidella americana						
Nebalia "pugettensis"						
Neotrypaea sp						
Orchomene decipiens						
Orchomene pacifica						
Orchomene pinguis						
Oregonia gracilis						
Pachynus barnardi					1	1
Pagurus sp		1			1	2
Parametaphoxus quaylei	2	3	3	3	7	18
Parasterope barnesi		1	2	2	1	6
Pardalisca tenuipes						
Photis brevipes						
Photis macrotica						
Photis sp						
Pinnixa occidentalis						
Pinnixa schmitti		1	1	1	1	4
Pinnixa sp	11	12	9	13	5	50
Pinnotheridae						
Pleurogonium californiense						
Pleurogonium rubicundum			1			1
Pleusymtes sp A						
Prachynella lodo						
Protomedeia prudens						
Protomedeia sp						
Rutiderma lomae	5	1	13	6	10	35
Scoloura phillipsi						
Solidobalanus hesperius	1	71		4	13	89
Spirontocaris sp						
Synchelidium pectinatum		1				1
Synchelidium rectipalmum						
Synchelidium sp						
Upogebia pugettensis					1	1
Westwoodilla caecula		4	5	2	4	15

REPLICATE TCRSTAB	**156**	**250**	**309**	**251**	**284**
REPLICATE TCRSTRC	**13**	**20**	**20**	**21**	**27**
STATION TCRSTAB	**1250**				
STATION TCRSTRC	**40**				

MISCELLANEOUS

Amphiodia periercta	1			1		2
Amphiodia sp. Indet.	3		1	4		8
Amphipholis sp. Indet.		1		1	2	4
Amphipholis squamata			1		1	2
Amphiuridae sp. Indet.						
Anthozoa sp. Indet.						

TAXON	EB87 2537-A	2537-B	2537-C	2537-D	2537-E	SppCount
Arhynchite pugettensis						
Asteroidea sp. Juv.						
Brachiopoda sp. Indet.						
Chiridota sp. Indet.						
Cucumaria piperata						
Cucumaria sp. Indet.						
Dendrochirotida sp. Indet.	1					1
Golfingia sp. Indet.						
Hirudinea sp. Indet.						
Leptosynapta clarki						
Leptosynapta transgressor						
Nemertinea sp. Indet.	9	4		1	4	18
Nynantheae sp. Indet.	2					2
Ophiura lutkeni		4		4		8
Ophiura sp. Indet.						
Ophiurida sp. Indet.	13	3	4	2	2	24
Pachycerianthus fimbriata						
Pentamera cf. pseudopopulifera						
Pentamera sp. Indet.						
Pentamera trachyplaca		2	1	1	1	5
Phoronida sp. Indet.						
Phoronis sp. Indet.						
Platyhelminthes sp. Indet.						
Sipunculida sp. Indet.	7		1			8
Solasteridae sp. Indet.						
Thysanocardia nigra			1			1
Turbellaria sp. Indet.		1				1

REPLICATE TMISCAB	**36**	**15**	**9**	**14**	**10**
REPLICATE TMISCRC	**7**	**6**	**6**	**7**	**5**
STATION TMISCAB	**84**				
STATION TMISCRC	**13**				
REPLICATE TABUND	**1175**	**1065**	**1320**	**1185**	**1264**
REPLICATE TRICH	**112**	**106**	**109**	**109**	**121**
STATION TABUND	**6009**				
STATION TRICH	**205**				

TAXON	2541-A	2541-B	2541-C	2541-D	2541-E	SppCount
	EB104					
POLYCHAETA						
Amage anops						
Ampharete finmarchica		2	2	1		5
Ampharete labrops						
Ampharete nr. crassiseta		2				2
Ampharete sp. Indet./Juv.	1			1		2
Ampharetidae sp. Indet./Juv.						
Amphicteis mucronata						
Amphitrite edwardsi	1					1
Amphitrite robusta						
Anobothrus gracilis	1	5	3	3	2	14
Aphelochaeta monilaris	5	4	6	4	3	22
Aphelochaeta sp. 2						
Aphelochaeta sp. Indet.		3		8		11
Aphelochaeta sp. N-1	3			5	1	9
Aphrodita japonica						
Aphrodita sp. Juv.						
Apistobranchus ornatus	2				1	3
Aricidea lopezi	2					2
Aricidea ramosa						
Armandia brevis		2				2
Artacama coniferi						
Artacamella hancocki						
Asabellides lineata						
Asclerocheilus beringianus		2				2
Autolytinae sp. Indet.						
Barantolla americana				1	1	2
Barantolla sp. Juv.						
Betapista dekkerae		1				1
Bispira sp. Indet.						
Boccardiella hamata						
Capitella capitata 'hyperspecies'						
Capitellidae sp. Indet./Juv.			1	1		2
Caulleriella pacifica		2	1	3		6
Chaetopteridae sp. Indet.						
Chaetopterus nr. variopedatus						
Chaetozone acuta						
Chaetozone nr. setosa	4	3	17	2	3	29
Chaetozone sp. Indet.						
Chone duneri						
Chone sp. Indet.						
Cirratulidae sp. Indet./Juv.	2	21	20	6	5	54
Cirratulus sp. Juv.						
Cirratulus spectabilis						
'Clymenura' gracilis		1	2		1	4
Cossura pygodactylata						
Cossura sp. Indet./Juv.	1	2	5		1	9
Diopatra ornata	1				1	2
Dipolydora akaina			3			3
Dipolydora cardalia		3	2	1	2	8
Dipolydora socialis				1		1
Dorvillea pseudorubrovittata			1			1

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB104

	EB104					
TAXON	2541-A	2541-B	2541-C	2541-D	2541-E	SppCount
Dorvillea rudolphi						
Dorvillea sp. Indet.				1		1
Dorvilleidae sp. Indet.			1			1
Drilonereis falcata						
Drilonereis longa						
Ehlersia heterochaeta	2	14	7	8	7	38
Ehlersia hyperioni	10	12	4	9	17	52
Epidiopatra hypferiona monroi						
Errano bicirrata						
Eteone sp. Indet.	1	2	3	1		7
Euchone incolor			1			1
Euclymeninae sp. Indet./Juv.	2					2
Eulalia californiensis	2	2	1		2	7
Eulalia nr. levicornuta						
Eulalia sp. 1						
Eumida longicornuta	1	11	5	3	1	21
Eusyllis habei		2				2
Exogone lourei		2	1	3	1	7
Exogone molesta						
Galathowenia oculata						
Gattyana ciliata		2	1			3
Gattyana cirrosa	2	6		4	1	13
Glycera americana						
Glycera nana	17	8	12	8	15	60
Glycinde armigera	5	1	1	1		8
Glycinde polygnatha						
Goniada maculata						
Harmothoe fragilis						
Harmothoe imbricata						
Hesionidae sp. Indet./Juv.						
Heteromastus filobranchus	1	2		1		4
Idanthyrsus saxicavus		1		1		2
Isocirrus longiceps	3	3	1	3	1	11
Lanassa nordenskioldi	9		2			11
Lanassa sp. Indet.				1		1
Lanassa venusta			1			1
Laonice cirrata	4	7	1	5	1	18
Leitoscoloplos pugettensis	1					1
Lepidasthenia berkeleyae						
Lepidasthenia longicirrata						
Lepidasthenia sp. Indet./Juv.						
Lepidonotus spiculus		5				5
Levinsenia gracilis	6	5	4		2	17
Lumbrineridae sp. Indet./Juv.	4		2	2	4	12
Lumbrineris californiensis	10	27	10	23	11	81
Lumbrineris cruzensis			1		2	3
Lumbrineris limicola						
Lumbrineris sp. Indet.						
Magelona longicornis	1	1	2	2	1	7
Magelona sp. Juv.						
Maldane sarsi	1					1
Maldanidae sp. Indet./Juv.	4	2	1	1	1	9

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB104

	EB104					
TAXON	2541-A	2541-B	2541-C	2541-D	2541-E	SppCount
Maldaninae sp. Indet.						
Malmgreniella bansei						
Malmgreniella berkeleyorum						
Malmgreniella liei						
Malmgreniella sp. Juv.						
Mediomastus ambiseta						
Mediomastus californiensis						
Mediomastus sp. Indet.	4	7	10	8	4	**33**
Megalomma splendida						
Mesochaetopterus taylori	2	6		1	3	**12**
Metascyhis disparadentata						
Microphthalmus sp. Indet.			4	7	1	**12**
Micropodarke dubia				1		**1**
Monticellina serratiseta		1	5	1	2	**9**
Monticellina sp. A						
Monticellina sp. Indet.						
Myriochele heeri	1		8		1	**10**
Myxicola infundibulum						
Neosabellaria cementarium						
Nephtys cornuta	5	7	10	6	7	**35**
Nephtys ferruginea	8		5	2	5	**20**
Nephtys sp. Indet./Juv.		13	5	3	4	**25**
Nereis procera		2				**2**
Nereis sp. Juv.						
Nereis zonata						
Nicomache personata						
Notocirrus californiensis					1	**1**
Notomastus latericius						
Notomastus tenuis	1	6	5	1	7	**20**
Notoproctus pacificus						
Odontosyllis phosphorea						
Oligochaeta sp. Indet.			3			**3**
Onuphidae sp. Indet./Juv.	2					**2**
Onuphis elegans						
Onuphis iridescens	1	1	1	5	3	**11**
Onuphis sp. Juv.						
Ophelina acuminata	1					**1**
Owenia fusiformis						
Paleonotus bellis		2			1	**3**
Parandalia fauveli	1	3	7	4	4	**19**
Paraprionospio pinnata	14	10	13	7	9	**53**
Parougia caeca		2		1		**3**
Pectianria californiensis	33	32	31	19	19	**134**
Pectinaria granulata	2	5	6	7	9	**29**
Pectinaria sp. Juv.						
Pherusa plumosa						
Pholoe glabra						
Pholoe sp. Indet.						
Pholoides asperus	8	117	15	58	31	**229**
Phyllochaetopterus prolifica						
Phyllodoce groenlandica	1	2	3	1	4	**11**
Phyllodoce hartmanae	1					**1**

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB104

				EB104		
TAXON	2541-A	2541-B	2541-C	2541-D	2541-E	SppCount
Phyllodoce sp. Juv.						
Phyllodoce williamsi		2				**2**
Phylo felix						
Pilargis maculata	3	4	6	6	7	**26**
Pionosyllis uraga						
Pista bansei			2			**2**
Pista brevibranchiata				2		**2**
Pista elongata						
Pista sp. Juv.						
Platynereis bicanaliculata						
Podarke pugettensis	1	1		2		**4**
Podarkeopsis glabrus	1	5	3	1	6	**16**
Polycirrus californicus						
Polycirrus sp. complex						
Polydora caulleryi			21	5	2	**28**
Polydora limicola						
Polydora sp. Indet./Juv.	1		1			**2**
Polynoidae sp. Indet.	1	3	1	1		**6**
Praxillella gracilis						
Praxillella pacifica						
Praxillella sp. Indet.						
Prionospio jubata	76	95	90	86	83	**430**
Prionospio lighti		16	7	4	6	**33**
Prionospio multibranchiata						
Prionospio sp. Indet.						
Procerea cornuta						
Proclea graffi		2	6	6	4	**18**
Protodorvillea gracilis						
Pseudopotamilla myriops						
Pseudopotamilla neglecta						
Rhodine bitorquata		1	2			**3**
Sabellidae sp. Indet.		2				**2**
Scalibregma inflatum						
Schistocomus hiltoni						
Scionella japonica		1				**1**
Scolelepis texana						
Scoletoma luti	18	6	6	6	9	**45**
Sigambra sp. Juv.						
Sigambra tentaculata	1			4	2	**7**
Sphaerodoropsis sphaerulifer	8	2	14	11	4	**39**
Sphaerosyllis ranunculus			1			**1**
Spio cirrifera				1		**1**
Spiochaetopterus costarum	18	13	50	79	26	**186**
Spionidae sp. Indet./Juv.						
Spiophanes berkeleyorum	1	1				**2**
Spiophanes bombyx			1			**1**
Sternaspis scutata	1					**1**
Sthenalais tertiaglabra						
Streblosoma bairdi						
Streblosoma sp. Juv.						
Syllidae sp. Indet./Juv.						
Tenonia priops	1		2			**3**

TAXON	EB104 2541-A	2541-B	2541-C	2541-D	2541-E	SppCount
Terebellidae sp. Indet./Juv.		1				1
Terebellides californica						
Tharyx sp. Indet.						
Thelepus setosus				1		1
Travisia forbesii						
Travisia sp. Juv.						
Trochochaeta multisetosa	3	3	8	7	6	27
Typosyllis harti	2	2		7	2	13

REPLICATE TPOLYAB	**330**	**544**	**477**	**475**	**360**
REPLICATE TPOLYRC	**62**	**68**	**66**	**65**	**56**
STATION TPOLYAB	**2186**				
STATION TPOLYRC	**110**				

MOLLUSCA

Acila castrensis		1				1
Adontorhina cyclia						
Aeolidacea sp. 1						
Aeolidacea sp. 2			1			1
Alvania compacta			2	2		4
Astarte elliptica						
Astyris gausapata	2	1	20	2		25
Axinopsida serricata	480	180	350	234	237	1481
Balcis sp. Indet.		6	3	2	1	12
Barleeia sp. Indet.						
Bivalvia sp. Juv.		4			4	8
Boreotrophon sp. Indet.						
Cardiidae sp. Juv.						
Cardiomya pectinata						
Ceratostoma foliatum						
Chaetoderma sp. Indet.	1	5	2	3	1	12
Chlamys hastata						
Cingula sp. Indet.						
Clinocardium nuttalli						
Clinocardium sp. Juv.					1	1
Compsomyax subdiaphana			15	7	4	26
Crepipatella lingulata						
Cryptonatica affinis			1	2		3
Cyclocardia ventricosa						
Cylichna attonsa						
Delectopecten sp. Juv.						
Delectopecten vancouverensis						
Euspira lewisii						
Galeommatacea sp. Indet.						
Gastropoda sp. Juv.						
Gastropteron pacificum	1	4	2	1	1	9
Hiatella arctica	1	2				3
Kurtzia arteaga						
Lirobittium sp. Indet.						
Lucinoma annulatum	4	1	17	5	10	37
Lyonsia californica	4	2	9	4	3	22
Macoma calcarea	1					1

TAXON	2541-A	2541-B	2541-C	2541-D	2541-E	SppCount
				EB104		
Macoma carlottensis	362	25	10	55	13	465
Macoma elimata	3					3
Macoma moesta alaskana						
Macoma nasuta						
Macoma obliqua						
Macoma sp. Juv.	145	38	81	32	63	359
Macoma yoldiformis	2	2	3	2	2	11
Mactridae sp. Juv.						
Margarites pupillus						
Megacrenella columbiana	4	5	7	9	10	35
Musculus discors						
Musculus sp. Juv.						
Mya arenaria						
Mysella tumida	3	6		7	3	19
Mytilidae sp. Juv.						
Mytilus sp. Juv.					1	1
Nassarius mendicus						
Nemocardium centrifilosum	13	6	6		6	31
Nucula tenuis	4	4	3	2	2	15
Nuculana minuta	2	1	4	4	3	14
Nuculana sp. Indet.						
Nudibranchia sp. Indet.						
Odostomia sp. Indet.			1			1
Pandora filosa			7		1	8
Pandora sp. Juv.			1			1
Parvilucina tenuisculpta	35	50	102	118	70	375
Psephidia lordi				1		1
Retusa sp. Indet.						
Rictaxis punctocaelatus						
Solen sicarius						
Tellina sp. Juv.						
Teredinidae sp. Indet.						
Thracia trapezoides						
Thyasira gouldi	1		1			2
Trichotopis cancellata						
Turbonilla sp. Indet.	1		4		1	6
Vitreolina columbiana						
Vitrinella columbiana						
Yoldia scissurata	4					4
Yoldia sp. Juv.						

REPLICATE TMOLLAB	**1073**	**343**	**652**	**492**	**437**
REPLICATE TMOLLRC	**21**	**19**	**24**	**19**	**21**
STATION TMOLLAB	**2997**				
STATION TMOLLRC	**34**				

CRUSTACEA

Ampelisca agassizi						
Ampelisca brevisimulata						
Ampelisca careyi		2			1	3
Ampelisca hancocki						
Ampelisca lobata		2	1	2		5

	EB104					
TAXON	2541-A	2541-B	2541-C	2541-D	2541-E	SppCount
Aoroides intermedia	1			3		**4**
Aoroides sp				1		**1**
Araphura sp A					1	**1**
Balanomorpha		9		5		**14**
Byblis millsi	3	2	5	1	2	**13**
Campylaspis hartae						
Campylaspis rubromaculata						
Cancer gracilis			1			**1**
Cancer sp						
Caprella mendax						
Corophium baconi						
Corophium insidiosum	1	3			1	**5**
Crangon alaskensis	2					**2**
Crangon sp						
Cyclopoida	1					**1**
Cyphocaris challengeri						
Deflexilodes enigmaticus			1		1	**2**
Desdimelita desdichada						
Desdimelita transmelita	1					**1**
Diastylis paraspinulosa	3	2	2			**7**
Diastylis "santamariensis"	1	2			1	**4**
Discorsopagurus schmitti		1				**1**
Dyopedos monacanthus						
Eobrolgus chumashi		1				**1**
Eochelidium sp A						
Ericthonius brasiliensis						
Ericthonius rubricornis						
Eualus sp						
Eudorella pacifica	16	6	13	7	4	**46**
Eudorellopsis longirostris	1		1	1	1	**4**
Euphilomedes carcharodonta	165	109	134	119	124	**651**
Euphilomedes producta	145	59	87	87	58	**436**
Euphilomedes sp	1					**1**
Eusirus columbianus	1					**1**
Eyakia robustus						
Haliophasma geminatum	2				1	**3**
Heptacarpus brevirostris						
Heterophoxus conlanae	2	7	2	8	5	**24**
Heterophoxus sp	1					**1**
Hippolytidae	2	1	2			**5**
Hippomedon sp A						
Leptochelia dubia		1				**1**
Leptognathia gracilis		1				**1**
Leptognathia sp E						
Leucon sp A	1		1		1	**3**
Limnoria lignorum		1				**1**
Lophopanopeus sp						
Majidae						
Mayerella banksia	1				1	**2**
Melphisana "bola"						
Mesocrangon munitella		1	1			**2**
Metacaprella anomala						

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Station EB104

TAXON	EB104 2541-A	2541-B	2541-C	2541-D	2541-E	SppCount
Metaphoxus frequens	1					1
Microjassa litotes						
Munna fernaldi						
Munnogonium tillerae						
Mysidae	1					1
Mysidella americana				1		1
Nebalia "pugettensis"						
Neotrypaea sp		1				1
Orchomene decipiens						
Orchomene pacifica	1					1
Orchomene pinguis						
Oregonia gracilis						
Pachynus barnardi		1				1
Pagurus sp						
Parametaphoxus quaylei	1	4	1		3	9
Parasterope barnesi	1	4	4			9
Pardalisca tenuipes						
Photis brevipes						
Photis macrotica						
Photis sp						
Pinnixa occidentalis						
Pinnixa schmitti				1		1
Pinnixa sp		2	3	5	2	12
Pinnotheridae	1					1
Pleurogonium californiense						
Pleurogonium rubicundum						
Pleusymtes sp A						
Prachynella lodo	1					1
Protomedeia prudens						
Protomedeia sp						
Rutiderma lomae	14	24	27	17	24	106
Scoloura phillipsi						
Solidobalanus hesperius		37		10	2	49
Spirontocaris sp						
Synchelidium pectinatum	1					1
Synchelidium rectipalmum						
Synchelidium sp						
Upogebia pugettensis	4			3		7
Westwoodilla caecula	2	1	3		2	8

REPLICATE TCRSTAB	**379**	**284**	**289**	**271**	**235**
REPLICATE TCRSTRC	**31**	**26**	**18**	**16**	**19**
STATION TCRSTAB	**1458**				
STATION TCRSTRC	**50**				

MISCELLANEOUS

Amphiodia periercta	4	2		10	2	18
Amphiodia sp. Indet.	8	4	2	9	4	27
Amphipholis sp. Indet.						
Amphipholis squamata			1			1
Amphiuridae sp. Indet.						
Anthozoa sp. Indet.						

	EB104					
TAXON	2541-A	2541-B	2541-C	2541-D	2541-E	SppCount
Arhynchite pugettensis						
Asteroidea sp. Juv.						
Brachiopoda sp. Indet.						
Chiridota sp. Indet.						
Cucumaria piperata						
Cucumaria sp. Indet.						
Dendrochirotida sp. Indet.						
Golfingia sp. Indet.						
Hirudinea sp. Indet.						
Leptosynapta clarki						
Leptosynapta transgressor						
Nemertinea sp. Indet.	8	12	1		5	**26**
Nynantheae sp. Indet.						
Ophiura lutkeni		1				**1**
Ophiura sp. Indet.						
Ophiurida sp. Indet.	10	21	11	15	11	**68**
Pachycerianthus fimbriata						
Pentamera cf. pseudopopulifera	1					**1**
Pentamera sp. Indet.					1	**1**
Pentamera trachyplaca		1	1			**2**
Phoronida sp. Indet.						
Phoronis sp. Indet.						
Platyhelminthes sp. Indet.						
Sipunculida sp. Indet.						
Solasteridae sp. Indet.						
Thysanocardia nigra						
Turbellaria sp. Indet.						

REPLICATE TMISCAB	**31**	**41**	**16**	**34**	**23**
REPLICATE TMISCRC	**5**	**6**	**5**	**3**	**5**
STATION TMISCAB	**145**				
STATION TMISCRC	**9**				
REPLICATE TABUND	**1813**	**1212**	**1434**	**1272**	**1055**
REPLICATE TRICH	**119**	**119**	**113**	**103**	**101**
STATION TABUND	**6786**				
STATION TRICH	**203**				

TAXON	2543-A	2543-B	2543-C	2543-D	2543-E	SppCount
			EB106			
POLYCHAETA						
Amage anops						
Ampharete finmarchica						
Ampharete labrops				1		**1**
Ampharete nr. crassiseta					1	**1**
Ampharete sp. Indet./Juv.		1				**1**
Ampharetidae sp. Indet./Juv.						
Amphicteis mucronata						
Amphitrite edwardsi		1	1			**2**
Amphitrite robusta						
Anobothrus gracilis	3	2	4	4	1	**14**
Aphelochaeta monilaris	1	2	2	1	2	**8**
Aphelochaeta sp. 2						
Aphelochaeta sp. Indet.						
Aphelochaeta sp. N-1	6		3	1		**10**
Aphrodita japonica						
Aphrodita sp. Juv.						
Apistobranchus ornatus		7	1		1	**9**
Aricidea lopezi	1					**1**
Aricidea ramosa						
Armandia brevis						
Artacama coniferi						
Artacamella hancocki						
Asabellides lineata						
Asclerocheilus beringianus						
Autolytinae sp. Indet.						
Barantolla americana			1	2	1	**4**
Barantolla sp. Juv.						
Betapista dekkerae						
Bispira sp. Indet.			1			**1**
Boccardiella hamata						
Capitella capitata 'hyperspecies'		2				**2**
Capitellidae sp. Indet./Juv.						
Caulleriella pacifica	1					**1**
Chaetopteridae sp. Indet.						
Chaetopterus nr. variopedatus						
Chaetozone acuta						
Chaetozone nr. setosa		4	2		1	**7**
Chaetozone sp. Indet.						
Chone duneri						
Chone sp. Indet.						
Cirratulidae sp. Indet./Juv.	2	4		4	3	**13**
Cirratulus sp. Juv.						
Cirratulus spectabilis		1				**1**
'Clymenura' gracilis				1		**1**
Cossura pygodactylata						
Cossura sp. Indet./Juv.		1				**1**
Diopatra ornata	1	1				**2**
Dipolydora akaina						
Dipolydora cardalia	1	2		1	1	**5**
Dipolydora socialis						
Dorvillea pseudorubrovittata						

	EB106					
TAXON	2543-A	2543-B	2543-C	2543-D	2543-E	SppCount
Dorvillea rudolphi						
Dorvillea sp. Indet.						
Dorvilleidae sp. Indet.		1				1
Drilonereis falcata		1			1	2
Drilonereis longa				1		1
Ehlersia heterochaeta		3	1	1		5
Ehlersia hyperioni	3	3		2		8
Epidiopatra hypferiona monroi			1			1
Errano bicirrata						
Eteone sp. Indet.	2			1		3
Euchone incolor	2					2
Euclymeninae sp. Indet./Juv.						
Eulalia californiensis		1				1
Eulalia nr. levicornuta						
Eulalia sp. 1						
Eumida longicornuta	4	16	9	13	3	45
Eusyllis habei						
Exogone lourei	1	1				2
Exogone molesta						
Galathowenia oculata						
Gattyana ciliata						
Gattyana cirrosa				2		2
Glycera americana						
Glycera nana	3	9	12	7	10	41
Glycinde armigera		4	2		6	12
Glycinde polygnatha						
Goniada maculata				1		1
Harmothoe fragilis						
Harmothoe imbricata						
Hesionidae sp. Indet./Juv.						
Heteromastus filobranchus	2	7	5	16		30
Idanthyrsus saxicavus						
Isocirrus longiceps						
Lanassa nordenskioldi		1				1
Lanassa sp. Indet.						
Lanassa venusta						
Laonice cirrata			1		2	3
Leitoscoloplos pugettensis			1			1
Lepidasthenia berkeleyae			2			2
Lepidasthenia longicirrata		1				1
Lepidasthenia sp. Indet./Juv.						
Lepidonotus spiculus						
Levinsenia gracilis	2					2
Lumbrineridae sp. Indet./Juv.	7	6	2	2	7	24
Lumbrineris californiensis	26	8	3	17	3	57
Lumbrineris cruzensis					1	1
Lumbrineris limicola			3			3
Lumbrineris sp. Indet.						
Magelona longicornis		21	12	23	21	77
Magelona sp. Juv.						
Maldane sarsi						
Maldanidae sp. Indet./Juv.				1		1

	EB106					
TAXON	2543-A	2543-B	2543-C	2543-D	2543-E	SppCount
Maldaninae sp. Indet.						
Malmgreniella bansei						
Malmgreniella berkeleyorum						
Malmgreniella liei						
Malmgreniella sp. Juv.						
Mediomastus ambiseta						
Mediomastus californiensis					1	**1**
Mediomastus sp. Indet.	10	9	5	14	1	**39**
Megalomma splendida		1				**1**
Mesochaetopterus taylori	1	2	1	2	3	**9**
Metascyhis disparadentata						
Microphthalmus sp. Indet.			1	2	1	**4**
Micropodarke dubia						
Monticellina serratiseta	1				1	**2**
Monticellina sp. A						
Monticellina sp. Indet.						
Myriochele heeri						
Myxicola infundibulum						
Neosabellaria cementarium						
Nephtys cornuta	4			1		**5**
Nephtys ferruginea	5	3	5	3	2	**18**
Nephtys sp. Indet./Juv.						
Nereis procera	1				1	**2**
Nereis sp. Juv.						
Nereis zonata						
Nicomache personata						
Notocirrus californiensis						
Notomastus latericius						
Notomastus tenuis	18	3	15	18	10	**64**
Notoproctus pacificus						
Odontosyllis phosphorea						
Oligochaeta sp. Indet.						
Onuphidae sp. Indet./Juv.						
Onuphis elegans		2			4	**6**
Onuphis iridescens			1	1		**2**
Onuphis sp. Juv.						
Ophelina acuminata						
Owenia fusiformis						
Paleonotus bellis						
Parandalia fauveli		1	1	2	2	**6**
Paraprionospio pinnata	7	10	16	15	19	**67**
Parougia caeca						
Pectianria californiensis	9		1	1	1	**12**
Pectinaria granulata	1	3	4	3	3	**14**
Pectinaria sp. Juv.						
Pherusa plumosa						
Pholoe glabra		1				**1**
Pholoe sp. Indet.						
Pholoides asperus	3					**3**
Phyllochaetopterus prolifica						
Phyllodoce groenlandica	3	1		1	4	**9**
Phyllodoce hartmanae		1	1	1		**3**

	EB106					
TAXON	2543-A	2543-B	2543-C	2543-D	2543-E	SppCount
Phyllodoce sp. Juv.						
Phyllodoce williamsi			2			2
Phylo felix						
Pilargis maculata	1			1	1	3
Pionosyllis uraga						
Pista bansei						
Pista brevibranchiata						
Pista elongata						
Pista sp. Juv.						
Platynereis bicanaliculata						
Podarke pugettensis						
Podarkeopsis glabrus	1	1				2
Polycirrus californicus		2		2		4
Polycirrus sp. complex						
Polydora caulleryi	1		1			2
Polydora limicola		3	6	1	3	13
Polydora sp. Indet./Juv.			1			1
Polynoidae sp. Indet.						
Praxillella gracilis						
Praxillella pacifica						
Praxillella sp. Indet.						
Prionospio jubata	47	13	15	16	8	99
Prionospio lighti	2			1		3
Prionospio multibranchiata						
Prionospio sp. Indet.						
Procerea cornuta						
Proclea graffi	1	1		1	1	4
Protodorvillea gracilis						
Pseudopotamilla myriops		1		1		2
Pseudopotamilla neglecta						
Rhodine bitorquata						
Sabellidae sp. Indet.						
Scalibregma inflatum						
Schistocomus hiltoni						
Scionella japonica						
Scolelepis texana						
Scoletoma luti	4	24	29	23	38	118
Sigambra sp. Juv.						
Sigambra tentaculata						
Sphaerodoropsis sphaerulifer	1	2				3
Sphaerosyllis ranunculus						
Spio cirrifera				1		1
Spiochaetopterus costarum	23	143	54	114	74	408
Spionidae sp. Indet./Juv.						
Spiophanes berkeleyorum		1	1	2	3	7
Spiophanes bombyx						
Sternaspis scutata						
Sthenalais tertiaglabra		1			1	2
Streblosoma bairdi						
Streblosoma sp. Juv.						
Syllidae sp. Indet./Juv.						
Tenonia priops	1	1	2			4

TAXON	2543-A	2543-B	2543-C	2543-D	2543-E	SppCount
			EB106			
Terebellidae sp. Indet./Juv.						
Terebellides californica						
Tharyx sp. Indet.	1		1			2
Thelepus setosus						
Travisia forbesii						
Travisia sp. Juv.						
Trochochaeta multisetosa				1		1
Typosyllis harti	5	3	7	8	6	29

REPLICATE TPOLYAB	219	344	239	338	253
REPLICATE TPOLYRC	42	52	43	47	40
STATION TPOLYAB	1393				
STATION TPOLYRC	89				

MOLLUSCA

Acila castrensis						
Adontorhina cyclia						
Aeolidacea sp. 1					1	1
Aeolidacea sp. 2						
Alvania compacta			1	1		2
Astarte elliptica						
Astyris gausapata	3	3	23	39	3	71
Axinopsida serricata	211	143	210	125	105	794
Balcis sp. Indet.			1			1
Barleeia sp. Indet.		1				1
Bivalvia sp. Juv.						
Boreotrophon sp. Indet.						
Cardiidae sp. Juv.						
Cardiomya pectinata						
Ceratostoma foliatum						
Chaetoderma sp. Indet.	1				1	2
Chlamys hastata						
Cingula sp. Indet.		1				1
Clinocardium nuttalli			1			1
Clinocardium sp. Juv.						
Compsomyax subdiaphana	2		4	2	2	10
Crepipatella lingulata						
Cryptonatica affinis						
Cyclocardia ventricosa						
Cylichna attonsa		1				1
Delectopecten sp. Juv.						
Delectopecten vancouverensis						
Euspira lewisii						
Galeommatacea sp. Indet.						
Gastropoda sp. Juv.						
Gastropteron pacificum			1		1	2
Hiatella arctica						
Kurtzia arteaga						
Lirobittium sp. Indet.						
Lucinoma annulatum	7	2		2	3	14
Lyonsia californica	2	1	1	1	1	6
Macoma calcarea	1					1

	EB106					
TAXON	2543-A	2543-B	2543-C	2543-D	2543-E	SppCount
Macoma carlottensis	25	22	40	30	29	**146**
Macoma elimata	1	3	3	4	3	**14**
Macoma moesta alaskana						
Macoma nasuta				2		**2**
Macoma obliqua	1					**1**
Macoma sp. Juv.	12	4		2		**18**
Macoma yoldiformis	6	8	14	8	11	**47**
Mactridae sp. Juv.						
Margarites pupillus						
Megacrenella columbiana	2	3	10	4	4	**23**
Musculus discors						
Musculus sp. Juv.						
Mya arenaria						
Mysella tumida			2		4	**6**
Mytilidae sp. Juv.						
Mytilus sp. Juv.						
Nassarius mendicus				1	1	**2**
Nemocardium centrifilosum	1					**1**
Nucula tenuis	2	3		1	1	**7**
Nuculana minuta			1	1		**2**
Nuculana sp. Indet.						
Nudibranchia sp. Indet.		1				**1**
Odostomia sp. Indet.		1				**1**
Pandora filosa	1		3			**4**
Pandora sp. Juv.						
Parvilucina tenuisculpta	89	43	80	39	52	**303**
Psephidia lordi	2	3	14	6	1	**26**
Retusa sp. Indet.						
Rictaxis punctocaelatus						
Solen sicarius		1	1		2	**4**
Tellina sp. Juv.						
Teredinidae sp. Indet.						
Thracia trapezoides						
Thyasira gouldi			4			**4**
Trichotopis cancellata						
Turbonilla sp. Indet.						
Vitreolina columbiana						
Vitrinella columbiana						
Yoldia scissurata						
Yoldia sp. Juv.						

REPLICATE TMOLLAB	**369**	**244**	**414**	**268**	**225**
REPLICATE TMOLLRC	**18**	**18**	**19**	**17**	**18**
STATION TMOLLAB	**1520**				
STATION TMOLLRC	**34**				

CRUSTACEA

Ampelisca agassizi						
Ampelisca brevisimulata						
Ampelisca careyi						
Ampelisca hancocki	1					**1**
Ampelisca lobata						

TAXON	EB106 2543-A	2543-B	2543-C	2543-D	2543-E	SppCount
Aoroides intermedia		2	3	2		7
Aoroides sp						
Araphura sp A						
Balanomorpha	4					4
Byblis millsi	1		2	1	4	8
Campylaspis hartae						
Campylaspis rubromaculata						
Cancer gracilis				4	1	5
Cancer sp	1					1
Caprella mendax			1	2		3
Corophium baconi						
Corophium insidiosum						
Crangon alaskensis						
Crangon sp						
Cyclopoida						
Cyphocaris challengeri						
Deflexilodes enigmaticus						
Desdimelita desdichada						
Desdimelita transmelita						
Diastylis paraspinulosa						
Diastylis "santamariensis"	1			2	1	4
Discorsopagurus schmitti						
Dyopedos monacanthus		2	1			3
Eobrolgus chumashi						
Eochelidium sp A	1					1
Ericthonius brasiliensis		2	1		2	5
Ericthonius rubricornis						
Eualus sp						
Eudorella pacifica	3	1	3	3	4	14
Eudorellopsis longirostris						
Euphilomedes carcharodonta	76	90	80	94	76	416
Euphilomedes producta	5	10	4	12	4	35
Euphilomedes sp						
Eusirus columbianus						
Eyakia robustus						
Haliophasma geminatum		1				1
Heptacarpus brevirostris						
Heterophoxus conlanae				1	1	2
Heterophoxus sp						
Hippolytidae						
Hippomedon sp A						
Leptochelia dubia						
Leptognathia gracilis						
Leptognathia sp E						
Leucon sp A						
Limnoria lignorum						
Lophopanopeus sp						
Majidae						
Mayerella banksia						
Melphisana "bola"						
Mesocrangon munitella			2			2
Metacaprella anomala						

	EB106					
TAXON	2543-A	2543-B	2543-C	2543-D	2543-E	SppCount
Metaphoxus frequens						
Microjassa litotes						
Munna fernaldi						
Munnogonium tillerae						
Mysidae						
Mysidella americana						
Nebalia "pugettensis"		1				1
Neotrypaea sp	1	1	2	1	1	6
Orchomene decipiens						
Orchomene pacifica						
Orchomene pinguis						
Oregonia gracilis						
Pachynus barnardi						
Pagurus sp			1			1
Parametaphoxus quaylei						
Parasterope barnesi			1		1	2
Pardalisca tenuipes						
Photis brevipes				1	3	4
Photis macrotica						
Photis sp						
Pinnixa occidentalis						
Pinnixa schmitti		1	1	4		6
Pinnixa sp	2	10	1	7	1	21
Pinnotheridae						
Pleurogonium californiense						
Pleurogonium rubicundum						
Pleusymtes sp A				1		1
Prachynella lodo						
Protomedeia prudens						
Protomedeia sp						
Rutiderma lomae	1					1
Scoloura phillipsi						
Solidobalanus hesperius	3				1	4
Spirontocaris sp			1			1
Synchelidium pectinatum						
Synchelidium rectipalmum						
Synchelidium sp						
Upogebia pugettensis						
Westwoodilla caecula	3	2	1	1	1	8

REPLICATE TCRSTAB	**103**	**123**	**105**	**136**	**101**
REPLICATE TCRSTRC	**14**	**12**	**16**	**15**	**14**
STATION TCRSTAB	**568**				
STATION TCRSTRC	**29**				

MISCELLANEOUS

Amphiodia periercta	2	6	1		3	12
Amphiodia sp. Indet.	7	9	7		6	29
Amphipholis sp. Indet.						
Amphipholis squamata						
Amphiuridae sp. Indet.						
Anthozoa sp. Indet.						

TAXON	2543-A	2543-B	2543-C	2543-D	2543-E	SppCount
				EB106		
Arhynchite pugettensis		7			4	**11**
Asteroidea sp. Juv.						
Brachiopoda sp. Indet.						
Chiridota sp. Indet.						
Cucumaria piperata						
Cucumaria sp. Indet.						
Dendrochirotida sp. Indet.						
Golfingia sp. Indet.						
Hirudinea sp. Indet.						
Leptosynapta clarki						
Leptosynapta transgressor						
Nemertinea sp. Indet.	6	9	8	3	8	**34**
Nynantheae sp. Indet.		1				**1**
Ophiura lutkeni		1	2		1	**4**
Ophiura sp. Indet.						
Ophiurida sp. Indet.	4	13	10		9	**36**
Pachycerianthus fimbriata						
Pentamera cf. pseudopopulifera		2	2			**4**
Pentamera sp. Indet.	1				3	**4**
Pentamera trachyplaca	4		3		2	**9**
Phoronida sp. Indet.						
Phoronis sp. Indet.						
Platyhelminthes sp. Indet.					1	**1**
Sipunculida sp. Indet.		7	6	2	5	**20**
Solasteridae sp. Indet.						
Thysanocardia nigra		1				**1**
Turbellaria sp. Indet.						

REPLICATE TMISCAB	**24**	**56**	**39**	**5**	**42**
REPLICATE TMISCRC	**6**	**10**	**8**	**2**	**10**
STATION TMISCAB	**166**				
STATION TMISCRC	**13**				
REPLICATE TABUND	**715**	**767**	**797**	**747**	**621**
REPLICATE TRICH	**80**	**92**	**86**	**81**	**82**
STATION TABUND	**3647**				
STATION TRICH	**165**				

	BK01M					
TAXON	2545-A	2545-B	2545-C	2545-D	2545-E	SppCount
POLYCHAETA						
Amage anops	2	11	9		2	**24**
Ampharete finmarchica		6	7	2		**15**
Ampharete labrops						
Ampharete nr. crassiseta				1		**1**
Ampharete sp. Indet./Juv.	3					**3**
Ampharetidae sp. Indet./Juv.	4		3	1		**8**
Amphicteis mucronata	2	2		3	1	**8**
Amphitrite edwardsi		4		11	1	**16**
Amphitrite robusta		4				**4**
Anobothrus gracilis	4		5	3	2	**14**
Aphelochaeta monilaris	5					**5**
Aphelochaeta sp. 2						
Aphelochaeta sp. Indet.	1		1	1	1	**4**
Aphelochaeta sp. N-1	2					**2**
Aphrodita japonica						
Aphrodita sp. Juv.						
Apistobranchus ornatus			1			**1**
Aricidea lopezi	4		7	1		**12**
Aricidea ramosa						
Armandia brevis						
Artacama coniferi						
Artacamella hancocki			1			**1**
Asabellides lineata	5		2		2	**9**
Asclerocheilus beringianus	5	9	4	8	2	**28**
Autolytinae sp. Indet.						
Barantolla americana						
Barantolla sp. Juv.						
Betapista dekkerae	15	18		10	5	**48**
Bispira sp. Indet.	28	9	2	1		**40**
Boccardiella hamata						
Capitella capitata 'hyperspecies'						
Capitellidae sp. Indet./Juv.	1	1	1			**3**
Caulleriella pacifica	10	4	3	2	6	**25**
Chaetopteridae sp. Indet.						
Chaetopterus nr. variopedatus				1		**1**
Chaetozone acuta			1	1		**2**
Chaetozone nr. setosa		2				**2**
Chaetozone sp. Indet.						
Chone duneri			1			**1**
Chone sp. Indet.			1	1		**2**
Cirratulidae sp. Indet./Juv.	10	7	7	2	2	**28**
Cirratulus sp. Juv.						
Cirratulus spectabilis						
'Clymenura' gracilis	2					**2**
Cossura pygodactylata						
Cossura sp. Indet./Juv.						
Diopatra ornata	1		1		2	**4**
Dipolydora akaina	1	5	1	23	9	**39**
Dipolydora cardalia		1	1	1	1	**4**
Dipolydora socialis		4	1			**5**
Dorvillea pseudorubrovittata					1	**1**

	BK01M					
TAXON	2545-A	2545-B	2545-C	2545-D	2545-E	SppCount
Dorvillea rudolphi		4	5	3		**12**
Dorvillea sp. Indet.						
Dorvilleidae sp. Indet.						
Drilonereis falcata						
Drilonereis longa				1		**1**
Ehlersia heterochaeta	26	24	20	32	25	**127**
Ehlersia hyperioni	12	17	9	7	1	**46**
Epidiopatra hypferiona monroi						
Errano bicirrata	1		1		1	**3**
Eteone sp. Indet.			2			**2**
Euchone incolor						
Euclymeninae sp. Indet./Juv.	1	1				**2**
Eulalia californiensis	3	1	4	1	3	**12**
Eulalia nr. levicornuta						
Eulalia sp. 1		1				**1**
Eumida longicornuta	15	11	5	9	1	**41**
Eusyllis habei		3	3	2		**8**
Exogone lourei		1				**1**
Exogone molesta						
Galathowenia oculata						
Gattyana ciliata	1	2	4		1	**8**
Gattyana cirrosa	2	3		10	3	**18**
Glycera americana						
Glycera nana	3	2	1	3	4	**13**
Glycinde armigera						
Glycinde polygnatha						
Goniada maculata	1	3	2	1	4	**11**
Harmothoe fragilis				2		**2**
Harmothoe imbricata				1		**1**
Hesionidae sp. Indet./Juv.						
Heteromastus filobranchus						
Idanthyrsus saxicavus				2		**2**
Isocirrus longiceps	1	1	1		1	**4**
Lanassa nordenskioldi						
Lanassa sp. Indet.						
Lanassa venusta						
Laonice cirrata	1	3		1		**5**
Leitoscoloplos pugettensis				1		**1**
Lepidasthenia berkeleyae						
Lepidasthenia longicirrata	6	5	3	8	5	**27**
Lepidasthenia sp. Indet./Juv.		1				**1**
Lepidonotus spiculus	2	1	3	11	2	**19**
Levinsenia gracilis						
Lumbrineridae sp. Indet./Juv.	7	8	7	4		**26**
Lumbrineris californiensis	17	20	5	28	13	**83**
Lumbrineris cruzensis	2			1		**3**
Lumbrineris limicola	1					**1**
Lumbrineris sp. Indet.					4	**4**
Magelona longicornis	5	11		2	8	**26**
Magelona sp. Juv.						
Maldane sarsi						
Maldanidae sp. Indet./Juv.	2	2		2		**6**

	BK01M					
TAXON	2545-A	2545-B	2545-C	2545-D	2545-E	SppCount
Maldaninae sp. Indet.						
Malmgreniella bansei				3	1	4
Malmgreniella berkeleyorum		1	2	2		5
Malmgreniella liei						
Malmgreniella sp. Juv.						
Mediomastus ambiseta						
Mediomastus californiensis						
Mediomastus sp. Indet.	15	10	10	9	2	46
Megalomma splendida	7	15	9	10	4	45
Mesochaetopterus taylori		1				1
Metascyhis disparadentata		1				1
Microphthalmus sp. Indet.						
Micropodarke dubia			1		1	2
Monticellina serratiseta						
Monticellina sp. A				4		4
Monticellina sp. Indet.						
Myriochele heeri					1	1
Myxicola infundibulum	11	1	2	1	5	20
Neosabellaria cementarium	16	5	3		3	27
Nephtys cornuta						
Nephtys ferruginea	1	7	9	4	3	24
Nephtys sp. Indet./Juv.						
Nereis procera		1	1		1	3
Nereis sp. Juv.	1					1
Nereis zonata						
Nicomache personata	2	1		1	1	5
Notocirrus californiensis				1		1
Notomastus latericius	12	2		4	4	22
Notomastus tenuis	14	20	14	23	21	92
Notoproctus pacificus	7	23		14	3	47
Odontosyllis phosphorea	2					2
Oligochaeta sp. Indet.						
Onuphidae sp. Indet./Juv.						
Onuphis elegans						
Onuphis iridescens	1		1	1		3
Onuphis sp. Juv.						
Ophelina acuminata	2					2
Owenia fusiformis						
Paleonotus bellis	1			1		2
Parandalia fauveli						
Paraprionospio pinnata	2	1	5	1		9
Parougia caeca						
Pectianria californiensis	4	2	4	3	2	15
Pectinaria granulata	3	1	1	1		6
Pectinaria sp. Juv.		1				1
Pherusa plumosa	2			2		4
Pholoe glabra		2	1		1	4
Pholoe sp. Indet.						
Pholoides asperus	40	27	20	22	13	122
Phyllochaetopterus prolifica	12	6	8		2	28
Phyllodoce groenlandica		1			1	2
Phyllodoce hartmanae						

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Background Station BK01 (Magnolia)

	BK01M					
TAXON	2545-A	2545-B	2545-C	2545-D	2545-E	SppCount
Phyllodoce sp. Juv.			1			1
Phyllodoce williamsi					2	2
Phylo felix						
Pilargis maculata						
Pionosyllis uraga	1					1
Pista bansei	2	3	1	1	2	9
Pista brevibranchiata	2	3	2	4	6	17
Pista elongata	2		9			11
Pista sp. Juv.						
Platynereis bicanaliculata						
Podarke pugettensis		1				1
Podarkeopsis glabrus						
Polycirrus californicus	2	3	4			9
Polycirrus sp. complex					2	2
Polydora caulleryi		2				2
Polydora limicola	1	1	1			3
Polydora sp. Indet./Juv.	3	6			2	11
Polynoidae sp. Indet.	4	6		6	2	18
Praxillella gracilis						
Praxillella pacifica						
Praxillella sp. Indet.						
Prionospio jubata	2	1		1		4
Prionospio lighti		3	5	1		9
Prionospio multibranchiata						
Prionospio sp. Indet.						
Procerea cornuta						
Proclea graffi	23	16	17	7	9	72
Protodorvillea gracilis						
Pseudopotamilla myriops						
Pseudopotamilla neglecta		1				1
Rhodine bitorquata	1		1			2
Sabellidae sp. Indet.	36	13	5	3	6	63
Scalibregma inflatum			1			1
Schistocomus hiltoni	6	9	3	8	6	32
Scionella japonica	1			2		3
Scolelepis texana		1				1
Scoletoma luti						
Sigambra sp. Juv.						
Sigambra tentaculata						
Sphaerodoropsis sphaerulifer						
Sphaerosyllis ranunculus						
Spio cirrifera						
Spiochaetopterus costarum	2	4	2	3	1	12
Spionidae sp. Indet./Juv.	2					2
Spiophanes berkeleyorum	3	5	2	5	1	16
Spiophanes bombyx						
Sternaspis scutata						
Sthenalais tertiaglabra			2			2
Streblosoma bairdi					1	1
Streblosoma sp. Juv.	8			2	3	13
Syllidae sp. Indet./Juv.	1		2	1		4
Tenonia priops						

	BK01M					
TAXON	2545-A	2545-B	2545-C	2545-D	2545-E	SppCount
Terebellidae sp. Indet./Juv.	12	6	5	6	3	**32**
Terebellides californica	4	2	5		1	**12**
Tharyx sp. Indet.						
Thelepus setosus			4			**4**
Travisia forbesii	3	4	3	3	9	**22**
Travisia sp. Juv.	1					**1**
Trochochaeta multisetosa						
Typosyllis harti	1	2	6	3	6	**18**

REPLICATE TPOLYAB	**492**	**433**	**307**	**368**	**244**
REPLICATE TPOLYRC	**83**	**79**	**74**	**75**	**64**
STATION TPOLYAB	**1844**				
STATION TPOLYRC	**134**				

MOLLUSCA

Acila castrensis						
Adontorhina cyclia	4	7	2	1	5	**19**
Aeolidacea sp. 1						
Aeolidacea sp. 2						
Alvania compacta	2	7	1	2		**12**
Astarte elliptica	2	3				**5**
Astyris gausapata						
Axinopsida serricata	1	3		1	1	**6**
Balcis sp. Indet.	1		2	1		**4**
Barleeia sp. Indet.						
Bivalvia sp. Juv.						
Boreotrophon sp. Indet.		1		1	1	**3**
Cardiidae sp. Juv.	1					**1**
Cardiomya pectinata						
Ceratostoma foliatum		1				**1**
Chaetoderma sp. Indet.						
Chlamys hastata				1		**1**
Cingula sp. Indet.						
Clinocardium nuttalli						
Clinocardium sp. Juv.						
Compsomyax subdiaphana						
Crepipatella lingulata		5				**5**
Cryptonatica affinis						
Cyclocardia ventricosa	18	14	3	11	13	**59**
Cylichna attonsa						
Delectopecten sp. Juv.		2	2			**4**
Delectopecten vancouverensis		1				**1**
Euspira lewisii						
Galeommatacea sp. Indet.	1					**1**
Gastropoda sp. Juv.						
Gastropteron pacificum						
Hiatella arctica	35	47	43	30	16	**171**
Kurtzia arteaga			1	1		**2**
Lirobittium sp. Indet.			1		1	**2**
Lucinoma annulatum	1	4	2	1	2	**10**
Lyonsia californica	4	5	10	11	8	**38**
Macoma calcarea	2	1				**3**

	BK01M					
TAXON	2545-A	2545-B	2545-C	2545-D	2545-E	SppCount
Macoma carlottensis		5		1	1	7
Macoma elimata		1	1		1	3
Macoma moesta alaskana		4	4	2	2	12
Macoma nasuta						
Macoma obliqua						
Macoma sp. Juv.		1	1	1	1	4
Macoma yoldiformis		4	1			5
Mactridae sp. Juv.						
Margarites pupillus	4	11	2	4	3	24
Megacrenella columbiana	19	34	20	16	15	104
Musculus discors			2	1	4	7
Musculus sp. Juv.						
Mya arenaria		1				1
Mysella tumida						
Mytilidae sp. Juv.		1				1
Mytilus sp. Juv.	2		1	1	1	5
Nassarius mendicus						
Nemocardium centrifilosum	13	11	11	9	17	61
Nucula tenuis		1				1
Nuculana minuta	11	11	12	18	10	62
Nuculana sp. Indet.	2		1			3
Nudibranchia sp. Indet.						
Odostomia sp. Indet.	5	10	2	1	1	19
Pandora filosa				1		1
Pandora sp. Juv.						
Parvilucina tenuisculpta	4	2	5	3	3	17
Psephidia lordi	1			1		2
Retusa sp. Indet.		1		2		3
Rictaxis punctocaelatus						
Solen sicarius						
Tellina sp. Juv.						
Teredinidae sp. Indet.						
Thracia trapezoides						
Thyasira gouldi						
Trichotopis cancellata		2				2
Turbonilla sp. Indet.	2		1	4		7
Vitreolina columbiana	10	3	2	8	2	25
Vitrinella columbiana						
Yoldia scissurata						
Yoldia sp. Juv.						

REPLICATE TMOLLAB	**145**	**204**	**133**	**134**	**108**
REPLICATE TMOLLRC	**23**	**31**	**25**	**27**	**21**
STATION TMOLLAB	**724**				
STATION TMOLLRC	**43**				

CRUSTACEA

Ampelisca agassizi			1			1
Ampelisca brevisimulata						
Ampelisca careyi	1	1	5			7
Ampelisca hancocki				2		2
Ampelisca lobata	2		1		1	4

	BK01M					
TAXON	2545-A	2545-B	2545-C	2545-D	2545-E	SppCount
Aoroides intermedia	1	1	2		3	7
Aoroides sp						
Araphura sp A						
Balanomorpha						
Byblis millsi	4	4	7	3	1	19
Campylaspis hartae		1	1		1	3
Campylaspis rubromaculata						
Cancer gracilis						
Cancer sp						
Caprella mendax	5	3	2	4		14
Corophium baconi	6	1	1		1	9
Corophium insidiosum						
Crangon alaskensis						
Crangon sp						
Cyclopoida						
Cyphocaris challengeri	2					2
Deflexilodes enigmaticus				2		2
Desdimelita desdichada			2			2
Desdimelita transmelita						
Diastylis paraspinulosa						
Diastylis "santamariensis"						
Discorsopagurus schmitti						
Dyopedos monacanthus	2					2
Eobrolgus chumashi						
Eochelidium sp A						
Ericthonius brasiliensis						
Ericthonius rubricornis	2		1	2		5
Eualus sp						
Eudorella pacifica		3	2	1	2	8
Eudorellopsis longirostris	1	3	3	2		9
Euphilomedes carcharodonta	1		2	4		7
Euphilomedes producta	1	3				4
Euphilomedes sp						
Eusirus columbianus						
Eyakia robustus					1	1
Haliophasma geminatum						
Heptacarpus brevirostris			1			1
Heterophoxus conlanae						
Heterophoxus sp						
Hippolytidae	1			1		2
Hippomedon sp A	1	4	2	4	4	15
Leptochelia dubia						
Leptognathia gracilis						
Leptognathia sp E						
Leucon sp A						
Limnoria lignorum						
Lophopanopeus sp						
Majidae			1			1
Mayerella banksia	8	3	1		3	15
Melphisana "bola"			2			2
Mesocrangon munitella			1			1
Metacaprella anomala						

	BK01M					
TAXON	2545-A	2545-B	2545-C	2545-D	2545-E	SppCount
Metaphoxus frequens						
Microjassa litotes	1					1
Munna fernaldi	1					1
Munnogonium tillerae	1					1
Mysidae						
Mysidella americana						
Nebalia "pugettensis"						
Neotrypaea sp						
Orchomene decipiens						
Orchomene pacifica						
Orchomene pinguis				1		1
Oregonia gracilis	1					1
Pachynus barnardi						
Pagurus sp						
Parametaphoxus quaylei						
Parasterope barnesi						
Pardalisca tenuipes	1			2	1	4
Photis brevipes						
Photis macrotica	9	5	3	6	1	24
Photis sp						
Pinnixa occidentalis		3				3
Pinnixa schmitti						
Pinnixa sp				1	2	3
Pinnotheridae						
Pleurogonium californiense						
Pleurogonium rubicundum						
Pleusymtes sp A						
Prachynella lodo						
Protomedeia prudens					3	3
Protomedeia sp			1			1
Rutiderma lomae	1	1	4			6
Scoloura phillipsi				1		1
Solidobalanus hesperius						
Spirontocaris sp						
Synchelidium pectinatum						
Synchelidium rectipalmum		2		1		3
Synchelidium sp						
Upogebia pugettensis						
Westwoodilla caecula		1	1	2		4

REPLICATE TCRSTAB	**53**	**39**	**47**	**39**	**24**
REPLICATE TCRSTRC	**22**	**16**	**23**	**17**	**13**
STATION TCRSTAB	**202**				
STATION TCRSTRC	**41**				

MISCELLANEOUS

Amphiodia periercta						
Amphiodia sp. Indet.						
Amphipholis sp. Indet.	8	10	7	10	6	41
Amphipholis squamata	3	3	2	6	6	20
Amphiuridae sp. Indet.						
Anthozoa sp. Indet.	2	1				3

PSR Marine Sediments Unit - Phase 2 Benthic Infaunal Data for Background Station BK01 (Magnolia)

	BK01M					
TAXON	2545-A	2545-B	2545-C	2545-D	2545-E	SppCount
Arhynchite pugettensis	1					**1**
Asteroidea sp. Juv.				6	4	**10**
Brachiopoda sp. Indet.	1		1			**2**
Chiridota sp. Indet.					1	**1**
Cucumaria piperata	59	79	47	63	79	**327**
Cucumaria sp. Indet.	27	25	51	23	64	**190**
Dendrochirotida sp. Indet.		1	4			**5**
Golfingia sp. Indet.		1				**1**
Hirudinea sp. Indet.						
Leptosynapta clarki	1		1			**2**
Leptosynapta transgressor	1	2	1	3	1	**8**
Nemertinea sp. Indet.	10	5	6	9	7	**37**
Nynantheae sp. Indet.	1	1	1			**3**
Ophiura lutkeni						
Ophiura sp. Indet.						
Ophiurida sp. Indet.			2	3	3	**8**
Pachycerianthus fimbriata		1				**1**
Pentamera cf. pseudopopulifera					1	**1**
Pentamera sp. Indet.	75	84	110	54	206	**529**
Pentamera trachyplaca					1	**1**
Phoronida sp. Indet.				1	2	**3**
Phoronis sp. Indet.						
Platyhelminthes sp. Indet.		3			1	**4**
Sipunculida sp. Indet.	5	4	4	18	14	**45**
Solasteridae sp. Indet.	5	3	3			**11**
Thysanocardia nigra						
Turbellaria sp. Indet.						

REPLICATE TMISCAB	**199**	**223**	**240**	**196**	**396**
REPLICATE TMISCRC	**14**	**15**	**14**	**11**	**15**
STATION TMISCAB	**1254**				
STATION TMISCRC	**24**				
REPLICATE TABUND	**889**	**899**	**727**	**737**	**772**
REPLICATE TRICH	**142**	**141**	**136**	**130**	**113**
STATION TABUND	**4024**				
STATION TRICH	**242**				

	BK04A					
TAXON	2546-A	2546-B	2546-C	2546-D	2546-E	SppCount
POLYCHAETA						
Amage anops			1			1
Ampharete finmarchica		4	1			5
Ampharete labrops						
Ampharete nr. crassiseta						
Ampharete sp. Indet./Juv.						
Ampharetidae sp. Indet./Juv.						
Amphicteis mucronata						
Amphitrite edwardsi						
Amphitrite robusta						
Anobothrus gracilis				1		1
Aphelochaeta monilaris	3	1				4
Aphelochaeta sp. 2						
Aphelochaeta sp. Indet.		3				3
Aphelochaeta sp. N-1						
Aphrodita japonica						
Aphrodita sp. Juv.		1				1
Apistobranchus ornatus	1		3	1		5
Aricidea lopezi	4	3	2	1	5	15
Aricidea ramosa					2	2
Armandia brevis						
Artacama coniferi						
Artacamella hancocki						
Asabellides lineata		2				2
Asclerocheilus beringianus						
Autolytinae sp. Indet.		2				2
Barantolla americana						
Barantolla sp. Juv.						
Betapista dekkerae						
Bispira sp. Indet.						
Boccardiella hamata			1			1
Capitella capitata 'hyperspecies'						
Capitellidae sp. Indet./Juv.						
Caulleriella pacifica						
Chaetopteridae sp. Indet.						
Chaetopterus nr. variopedatus						
Chaetozone acuta						
Chaetozone nr. setosa	8	8		3	3	22
Chaetozone sp. Indet.						
Chone duneri						
Chone sp. Indet.						
Cirratulidae sp. Indet./Juv.	3	3	5	6	4	21
Cirratulus sp. Juv.						
Cirratulus spectabilis						
'Clymenura' gracilis	8	2	10	4	4	28
Cossura pygodactylata						
Cossura sp. Indet./Juv.						
Diopatra ornata						
Dipolydora akaina						
Dipolydora cardalia						
Dipolydora socialis						
Dorvillea pseudorubrovittata						

	BK04A					
TAXON	2546-A	2546-B	2546-C	2546-D	2546-E	SppCount
Dorvillea rudolphi						
Dorvillea sp. Indet.						
Dorvilleidae sp. Indet.						
Drilonereis falcata						
Drilonereis longa						
Ehlersia heterochaeta						
Ehlersia hyperioni						
Epidiopatra hypferiona monroi			1			1
Errano bicirrata						
Eteone sp. Indet.	1		1			2
Euchone incolor						
Euclymeninae sp. Indet./Juv.	4	6				10
Eulalia californiensis						
Eulalia nr. levicornuta						
Eulalia sp. 1						
Eumida longicornuta	1				2	3
Eusyllis habei						
Exogone lourei	1		1	1	1	4
Exogone molesta						
Galathowenia oculata			1			1
Gattyana ciliata						
Gattyana cirrosa						
Glycera americana	1					1
Glycera nana	5	5	2	9	5	26
Glycinde armigera	2		2			4
Glycinde polygnatha						
Goniada maculata						
Harmothoe fragilis						
Harmothoe imbricata						
Hesionidae sp. Indet./Juv.						
Heteromastus filobranchus						
Idanthyrsus saxicavus						
Isocirrus longiceps		1	1		2	4
Lanassa nordenskioldi	21	16		18	4	59
Lanassa sp. Indet.						
Lanassa venusta			12		4	16
Laonice cirrata						
Leitoscoloplos pugettensis	10	5	7	13	2	37
Lepidasthenia berkeleyae						
Lepidasthenia longicirrata						
Lepidasthenia sp. Indet./Juv.				1		1
Lepidonotus spiculus						
Levinsenia gracilis				1		1
Lumbrineridae sp. Indet./Juv.	4	2	2	4	4	16
Lumbrineris californiensis						
Lumbrineris cruzensis						
Lumbrineris limicola						
Lumbrineris sp. Indet.						
Magelona longicornis	2		2	2	1	7
Magelona sp. Juv.						
Maldane sarsi						
Maldanidae sp. Indet./Juv.	1	1	5	6	6	19

	BK04A					
TAXON	2546-A	2546-B	2546-C	2546-D	2546-E	SppCount
Maldaninae sp. Indet.						
Malmgreniella bansei			1			1
Malmgreniella berkeleyorum						
Malmgreniella liei						
Malmgreniella sp. Juv.						
Mediomastus ambiseta						
Mediomastus californiensis						
Mediomastus sp. Indet.	2	7	3	2	4	18
Megalomma splendida	2			1	2	5
Mesochaetopterus taylori						
Metascyhis disparadentata	1					1
Microphthalmus sp. Indet.			2			2
Micropodarke dubia						
Monticellina serratiseta						
Monticellina sp. A						
Monticellina sp. Indet.						
Myriochele heeri	13	24	18	7	11	73
Myxicola infundibulum	1					1
Neosabellaria cementarium						
Nephtys cornuta	1		1		4	6
Nephtys ferruginea	1	3	1	4	7	16
Nephtys sp. Indet./Juv.	1	1	2		1	5
Nereis procera		2				2
Nereis sp. Juv.						
Nereis zonata						
Nicomache personata						
Notocirrus californiensis						
Notomastus latericius						
Notomastus tenuis	4	2	1	4		11
Notoproctus pacificus						
Odontosyllis phosphorea						
Oligochaeta sp. Indet.						
Onuphidae sp. Indet./Juv.	17	22	16	4	12	71
Onuphis elegans					4	4
Onuphis iridescens	2	3	1	8		14
Onuphis sp. Juv.						
Ophelina acuminata						
Owenia fusiformis						
Paleonotus bellis						
Parandalia fauveli						
Paraprionospio pinnata	7	6	10	5	5	33
Parougia caeca						
Pectianria californiensis	82	90	87	49	53	361
Pectinaria granulata	1		6		6	13
Pectinaria sp. Juv.						
Pherusa plumosa	1					1
Pholoe glabra	1		1	1	1	4
Pholoe sp. Indet.						
Pholoides asperus						
Phyllochaetopterus prolifica						
Phyllodoce groenlandica	2	1	1	1	3	8
Phyllodoce hartmanae	1					1

	BK04A					
TAXON	2546-A	2546-B	2546-C	2546-D	2546-E	SppCount
Phyllodoce sp. Juv.						
Phyllodoce williamsi						
Phylo felix	1			1	1	3
Pilargis maculata	1					1
Pionosyllis uraga						
Pista bansei			2		1	3
Pista brevibranchiata			2	1	1	4
Pista elongata						
Pista sp. Juv.					1	1
Platynereis bicanaliculata		1				1
Podarke pugettensis						
Podarkeopsis glabrus					1	1
Polycirrus californicus	4		5	15	2	26
Polycirrus sp. complex		2	1	4	2	9
Polydora caulleryi			1			1
Polydora limicola						
Polydora sp. Indet./Juv.						
Polynoidae sp. Indet.				1	1	2
Praxillella gracilis			1			1
Praxillella pacifica						
Praxillella sp. Indet.						
Prionospio jubata	22	22	19	19	32	114
Prionospio lighti	1					1
Prionospio multibranchiata						
Prionospio sp. Indet.						
Procerea cornuta					1	1
Proclea graffi	2	5	15		18	40
Protodorvillea gracilis						
Pseudopotamilla myriops						
Pseudopotamilla neglecta						
Rhodine bitorquata	1		2	5	3	11
Sabellidae sp. Indet.	1					1
Scalibregma inflatum						
Schistocomus hiltoni						
Scionella japonica	2					2
Scolelepis texana						
Scoletoma luti	4	4	3	1	2	14
Sigambra sp. Juv.						
Sigambra tentaculata						
Sphaerodoropsis sphaerulifer	1	1	2		2	6
Sphaerosyllis ranunculus						
Spio cirrifera						
Spiochaetopterus costarum		1	2		1	4
Spionidae sp. Indet./Juv.						
Spiophanes berkeleyorum		1			1	2
Spiophanes bombyx						
Sternaspis scutata		1				1
Sthenalais tertiaglabra	2		1		1	4
Streblosoma bairdi						
Streblosoma sp. Juv.						
Syllidae sp. Indet./Juv.		2				2
Tenonia priops	1	2	1	1	1	6

TAXON	2546-A	2546-B	2546-C	2546-D	2546-E	SppCount
	BK04A					
Terebellidae sp. Indet./Juv.	3	2	3	3		11
Terebellides californica	1	2			1	4
Tharyx sp. Indet.						
Thelepus setosus						
Travisia forbesii		6	3	3	3	15
Travisia sp. Juv.						
Trochochaeta multisetosa	4	4		5	1	14
Typosyllis harti						

REPLICATE TPOLYAB	271	282	274	216	239
REPLICATE TPOLYRC	52	43	50	38	49
STATION TPOLYAB	1282				
STATION TPOLYRC	86				

MOLLUSCA

Acila castrensis						
Adontorhina cyclia	2	1	2	2	1	8
Aeolidacea sp. 1						
Aeolidacea sp. 2						
Alvania compacta	1	6				7
Astarte elliptica						
Astyris gausapata	1	75	5	7	12	100
Axinopsida serricata	81	63	104	71	68	387
Balcis sp. Indet.		1				1
Barleeia sp. Indet.						
Bivalvia sp. Juv.						
Boreotrophon sp. Indet.						
Cardiidae sp. Juv.						
Cardiomya pectinata	1	1		1	3	6
Ceratostoma foliatum						
Chaetoderma sp. Indet.		4		2	1	7
Chlamys hastata						
Cingula sp. Indet.						
Clinocardium nuttalli						
Clinocardium sp. Juv.			1			1
Compsomyax subdiaphana	2	3	13	4	7	29
Crepipatella lingulata						
Cryptonatica affinis						
Cyclocardia ventricosa						
Cylichna attonsa					1	1
Delectopecten sp. Juv.						
Delectopecten vancouverensis						
Euspira lewisii						
Galeommatacea sp. Indet.						
Gastropoda sp. Juv.						
Gastropteron pacificum				2	2	4
Hiatella arctica		2				2
Kurtzia arteaga			1			1
Lirobittium sp. Indet.	6	6	3	2	2	19
Lucinoma annulatum	6	10	3	12	5	36
Lyonsia californica	6	3	5	2	14	30
Macoma calcarea						

	BK04A					
TAXON	2546-A	2546-B	2546-C	2546-D	2546-E	SppCount
Macoma carlottensis	20	49	16	39	27	151
Macoma elimata		6	4	1	7	18
Macoma moesta alaskana						
Macoma nasuta		1				1
Macoma obliqua						
Macoma sp. Juv.	54	44	86	40	30	254
Macoma yoldiformis	4	9	4	7	8	32
Mactridae sp. Juv.		1				1
Margarites pupillus						
Megacrenella columbiana	9	7	17	4	5	42
Musculus discors						
Musculus sp. Juv.						
Mya arenaria						
Mysella tumida	2	4	1		2	9
Mytilidae sp. Juv.						
Mytilus sp. Juv.						
Nassarius mendicus						
Nemocardium centrifilosum	7	3	5	8	5	28
Nucula tenuis	2		1			3
Nuculana minuta	4	1	4	4		13
Nuculana sp. Indet.						
Nudibranchia sp. Indet.						
Odostomia sp. Indet.						
Pandora filosa	4				1	5
Pandora sp. Juv.						
Parvilucina tenuisculpta	29	20	33	29	31	142
Psephidia lordi						
Retusa sp. Indet.						
Rictaxis punctocaelatus						
Solen sicarius						
Tellina sp. Juv.						
Teredinidae sp. Indet.						
Thracia trapezoides		1				1
Thyasira gouldi		1				1
Trichotopis cancellata						
Turbonilla sp. Indet.	1	3	2			6
Vitreolina columbiana						
Vitrinella columbiana						
Yoldia scissurata	5	1	2	3	1	12
Yoldia sp. Juv.		1				1

REPLICATE TMOLLAB	247	327	312	240	233
REPLICATE TMOLLRC	21	28	21	19	21
STATION TMOLLAB	1359				
STATION TMOLLRC	34				

CRUSTACEA

Ampelisca agassizi						
Ampelisca brevisimulata	1		1			2
Ampelisca careyi						
Ampelisca hancocki						
Ampelisca lobata						

	BK04A					
TAXON	2546-A	2546-B	2546-C	2546-D	2546-E	SppCount
Aoroides intermedia						
Aoroides sp						
Araphura sp A		1				1
Balanomorpha						
Byblis millsi		1				1
Campylaspis hartae					1	1
Campylaspis rubromaculata						
Cancer gracilis						
Cancer sp						
Caprella mendax						
Corophium baconi						
Corophium insidiosum						
Crangon alaskensis		1	1			2
Crangon sp			1			1
Cyclopoida						
Cyphocaris challengeri						
Deflexilodes enigmaticus						
Desdimelita desdichada						
Desdimelita transmelita						
Diastylis paraspinulosa	4	3	4	1	5	17
Diastylis "santamariensis"		1			1	2
Discorsopagurus schmitti						
Dyopedos monacanthus						
Eobrolgus chumashi						
Eochelidium sp A						
Ericthonius brasiliensis						
Ericthonius rubricornis						
Eualus sp						
Eudorella pacifica	1	1		2	4	8
Eudorellopsis longirostris	1	1	2	3	2	9
Euphilomedes carcharodonta	51	56	34	39	60	240
Euphilomedes producta	56	66	43	78	69	312
Euphilomedes sp						
Eusirus columbianus						
Eyakia robustus						
Haliophasma geminatum			1	1		2
Heptacarpus brevirostris						
Heterophoxus conlanae						
Heterophoxus sp						
Hippolytidae			1			1
Hippomedon sp A	3	1		2		6
Leptochelia dubia		1				1
Leptognathia gracilis						
Leptognathia sp E						
Leucon sp A						
Limnoria lignorum						
Lophopanopeus sp						
Majidae						
Mayerella banksia					1	1
Melphisana "bola"						
Mesocrangon munitella						
Metacaprella anomala						

	BK04A					
TAXON	2546-A	2546-B	2546-C	2546-D	2546-E	SppCount
Metaphoxus frequens		2	1	1	2	6
Microjassa litotes						
Munna fernaldi						
Munnogonium tillerae						
Mysidae						
Mysidella americana						
Nebalia "pugettensis"						
Neotrypaea sp		1				1
Orchomene decipiens	1	1		2	2	6
Orchomene pacifica						
Orchomene pinguis	1					1
Oregonia gracilis						
Pachynus barnardi		1				1
Pagurus sp						
Parametaphoxus quaylei						
Parasterope barnesi						
Pardalisca tenuipes						
Photis brevipes						
Photis macrotica						
Photis sp						
Pinnixa occidentalis						
Pinnixa schmitti						
Pinnixa sp			2		1	3
Pinnotheridae						
Pleurogonium californiense						
Pleurogonium rubicundum						
Pleusymtes sp A						
Prachynella lodo						
Protomedeia prudens	3					3
Protomedeia sp						
Rutiderma lomae		3	1	1	5	10
Scoloura phillipsi		1			1	2
Solidobalanus hesperius	1					1
Spirontocaris sp						
Synchelidium pectinatum						
Synchelidium rectipalmum						
Synchelidium sp	1					1
Upogebia pugettensis	1					1
Westwoodilla caecula	1	2	3	4	1	11

REPLICATE TCRSTAB	**126**	**144**	**95**	**134**	**155**
REPLICATE TCRSTRC	**14**	**18**	**13**	**11**	**14**
STATION TCRSTAB	**654**				
STATION TCRSTRC	**30**				

MISCELLANEOUS

Amphiodia periercta	15	19		11	39	84
Amphiodia sp. Indet.	11	26		9	16	62
Amphipholis sp. Indet.						
Amphipholis squamata						
Amphiuridae sp. Indet.						
Anthozoa sp. Indet.						

	BK04A					
TAXON	2546-A	2546-B	2546-C	2546-D	2546-E	SppCount
Arhynchite pugettensis						
Asteroidea sp. Juv.						
Brachiopoda sp. Indet.						
Chiridota sp. Indet.						
Cucumaria piperata						
Cucumaria sp. Indet.						
Dendrochirotida sp. Indet.						
Golfingia sp. Indet.						
Hirudinea sp. Indet.		1				1
Leptosynapta clarki						
Leptosynapta transgressor						
Nemertinea sp. Indet.	6	4	5	6	4	25
Nynantheae sp. Indet.						
Ophiura lutkeni						
Ophiura sp. Indet.			1			1
Ophiurida sp. Indet.	25	39		21	63	148
Pachycerianthus fimbriata						
Pentamera cf. pseudopopulifera	2			1		3
Pentamera sp. Indet.						
Pentamera trachyplaca						
Phoronida sp. Indet.						
Phoronis sp. Indet.	1				1	2
Platyhelminthes sp. Indet.		1				1
Sipunculida sp. Indet.	3		1		1	5
Solasteridae sp. Indet.						
Thysanocardia nigra		2	1			3
Turbellaria sp. Indet.						

REPLICATE TMISCAB	63	92	8	48	124
REPLICATE TMISCRC	7	7	4	5	6
STATION TMISCAB	335				
STATION TMISCRC	11				
REPLICATE TABUND	707	845	689	638	751
REPLICATE TRICH	94	96	88	73	90
STATION TABUND	3630				
STATION TRICH	161				

ATTACHMENT K.2

LIFE HISTORIES FOR ECOLOGICAL RECEPTORS

ENGLISH SOLE
(*Parophrys vetulus*)

Spawning and Larvae

Although spawning activities of English sole has not been directly observed, spawning locations and times are inferred from the spatial and temporal distribution of either turgid or spent females or the presence of egg and larval stages within a given study area. Some studies suggest that spawning typically occurs over sand and sand-mud bottoms at depth of 60-110 meters (m). Spawning is thought to be most intense during winter (December - February), but is also known to occur throughout all seasons; peaks vary from September to April. Individual sole may spawn in more than once in a given year, but probably do not spawn serially within a given season. Although English sole spawn demersally, their eggs are buoyant in full-strength seawater. Hatching time varied from 3.5 to 12 days and depends on both temperature and salinity.

The larvae of English sole are pelagic and depend on favorable current patterns for transport to suitable nearshore nursery areas. The duration of this pelagic larval stage is generally cited as 6-10 weeks. As larvae reach 18-22 millimeters (mm) in total length they begin transforming to asymmetrical morphology and settle to a demersal existence.

Postlarvae and Juveniles

The settling periods for English sole are considered to vary widely even within a confined study area. Earlier studies concluded that estuaries alone served as the nursery areas for juvenile English sole, but more recent evidence suggests that shallow, open coastal water may also provide juvenile rearing habitat. Postlarval settlement occurs both in estuaries and along sand bottomed open coastlines, primarily at depths of less than 16 m. Growth rates of post-settlement, 0-age English sole are comparable in estuaries and open coastal sites. The number of juveniles at open-coast sites, however, decrease sharply after settlement.

Juveniles move progressively to deeper waters with growth and leave nursery areas at 140-150 mm in total length. The emigration from estuarine areas generally occurs from August through November. Several alternative cues to induce emigrations have been proposed, such as temperature, niche shift, and competition avoidance.

Adults

Male English sole typically mature at 2-3 years of age and females at 3-4 years of age. Adult English sole are almost entirely absent from coastal bays and estuaries, and are generally restricted to offshore sand or sand-mud substrates. Depths at which they are most abundant vary from approximately 20-70 m in summer to 40-130 m during winter months. This results from a seasonal bathymetric migration which is usually associated with a contranatant (against the current) movement to a movement with the current when returning from deep-water spawning grounds.

Mortality

As with most teleosts, mortality in English sole is greatest during early life-history stages. Temperature and salinity conditions, predation, adverse ocean advection, and absence of prey for larvae are considered to represent significant sources of mortality for eggs, larvae, and newly recruited juveniles. In adults, mortality rates vary widely with sex, age, and degree of fishing pressure. Investigations in Puget Sound demonstrated a greater mortality for females (36%) than males (33%) from the third to fifth years of life at one site, but the reverse was found for 8- to 10-year-old fish at a second study site.

Movement and Stocks

Studies have found that movement is largely restricted to seasonal spawning migrations in geographically segregated stocks. Within specific stocks of English sole there may be a fraction of highly migratory individuals. Migrations rates have been as high as 4 mi/day and tag recovery distance have been as high as 700 miles.

Within the Pacific Northwest region, Puget Sound English sole is recognized as a major spawning population. Although still questionable, some studies suggest (on the basis of tagging and recapture data) that English sole in Puget Sound demonstrate a pronounced homing instinct and further suggest that individuals may exhibit territorial behavior.

Feeding Behavior

Studies have found that the diet of larvae of English sole appear to be very specific. Appendicularians (*Oikopleura* spp.) represented a large component of the prey items consumed. Other food sources included tintinnids, invertebrate eggs, and nauplii. Early 0-age English sole are capable of expanding their prey selection to larger species. Harpacticoid copepods represent a major food component in their diet. Polychaete palps and juvenile bivalves also make up the prey assemblage of 0-age English sole.

Juvenile English sole are considered to be opportunistic and generalist benthic feeders, with selection only at the level of major taxonomic groups of prey. Within prey groups, the extent of dietary inclusion varies with local seasonal prey abundance. The most commonly found species predated by juvenile English sole include polychaetes, amphipods, cumaceans, and bivalve siphons. Studies have developed general patterns in the feeding behavior of juvenile English sole. These feeding strategies include a passive sit-and-wait behavior with occasional lunges at surface prey and an active disturbance of the upper few millimeters of sediment and subsequent feeding on fleeing prey. Studies have also suggested that juvenile English sole are primarily diurnal feeders.

The taxonomic composition of diets of adult English sole include shallow-burrowing and surface-active prey. Adult are also capable of digging into sediments to capture deeper-burrowing prey as well. Studies have found that the feeding habits of adult English sole are similar to those of juveniles. These studies found amphipods, polychaetes, and cumaceans to comprise the major dietary component of adults. Like juveniles, adult English sole were found to feed opportunistically on a wide variety of benthic invertebrates including shrimp, small molluscs and crabs, in addition to polychaetes.

In disturbed areas, the polychaetes *Capitella* spp. are abundant in localized densities. In these areas, English sole have exhibited significant numerical and size selection of this food source. Benthic assemblages dominated by species such as *Capitella* spp. may have comparatively high productivity and hence represent an enhance food source to English sole.

References

Lassuy, D.R. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Pacific Northwest) - - English sole. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.101). U.S. Army Corps of Engineers, TR EL-82-4/ 17 pp.

BENT-NOSED CLAM
(*Macoma nasuta*)

Habitat and Distribution

The bent-nosed clam is a small bivalve belonging to the family Tellinidae and is commonly less than 70 mm in length (**Rudy and Rudy, 1983; Kozloff, 1983**). The distribution of the bent-nosed extends from Kodiak Bay, Alaska to Baja, California. Bent-nosed clam are commonly found in bays as well as offshore areas below the surf zone. This species of bivalve is also considered fairly tolerant of varying salinity regimes and is adapted to a wide range of habitat conditions. The bent-nosed clam is most often found between 10 and 15 cm below substrate surface and typically utilizes areas consisting mainly of mud and muddy sand (**Rudy and Rudy, 1983**).

Spawning and Larvae

Spawning occurs during the spring and early-summer. During this period, eggs and sperm are discharged into the water through an excurrent siphon. Fertilized eggs develop into veliger larvae which swim, metamorphose, and settle as small clams (**Rudy and Rudy, 1983**).

Feeding Behavior

Previous investigations have demonstrated a correlation between the depth below the sediment surface and species inhabitants and the size of bent-nosed clams with the larger specimens found in deeper sediment (**Green, 1986**). When the tide is in, the bent-nosed clam is a suspension feeder. This species also behaves as a deposit feeder consuming bacterial film and microorganisms on the surface (**Rudy and Rudy, 1983**). The abundance of bent-nosed clam depends on the amount of food available and the amount of time available for feeding (Greene, 1968). Notable predators of the bent-nosed clam include crabs and snail (Polinices) (**Rudy and Rudy, 1983**).

References

Green, J. 1968. The Biology of Estuarine Animals. University of Washington Press, Seattle, WA

Kozloff, E.N. 1973. Seashore Life of the Northern Pacific Coast, An Illustrated Guide to Northern California, Oregon, Washington, and British Columbia. University of Washington Press, Seattle, WA. pp.370.

Rudy, P., and L.H. Rudy. 1983. Oregon Estuarine Invertebrates, An Illustrated Guide to the Common and Important Invertebrate Animals. Biological Services Program, Fish and Wildlife Program, U.S. Department of the Interior. FWS/OBS-83/16. September. pp. 225.

AMPHIPOD
(*Ampelisca abdita*)

Habitat and Distribution

The species of the amphipod crustacean known as *Ampelisca abdita* occurs throughout the shallow coastal waters (intertidal and subtidal zones) of eastern and western North America (**Mills, 1964**). *A. abdita* is a macrobenthic invertebrate (bottom dwelling) and prefers finer substrata as opposed to more coarse sand substrata. *A. abdita* co-occurs throughout its range with a another amphipod known as *Ampelisca vadorum*. *A. vadorum* prefers coarse substrata and appears to be the dominant species within this type of habitat. In general, amphipods (including *A. abdita*) have high oxygen requirements and are thus usually restricted to waters of high dissolved oxygen concentrations (**Franke, 1977**). They can be numerous and are an important food source to a variety of marine wildlife including fish, birds, and mammals.

Spawning and Larvae

Unlike most benthic organisms *A. abdita* does not appear to have an extensive pelagic period with larvae developing within the brood pouch of the female parent (**Stickney and Stringer, 1957**). This assures that the same areas will be populated year after year by successive generations, and while their extent may change or increase, this activity occurs by extension of the periphery rather than by seeding of scattered patches. Active predation by fish can lead to genetic selection of smaller sized adults and a smaller population in general. Rapid growth rates and short generation times during the spawning and growing seasons (spring to fall) are also quite common (**Wetzel, 1983**). This leads to higher than normal production rates triggered more often by increases in the food supply rather than specific times of the year.

Feeding Behavior

Amphipods (including *A. abdita*) are primarily omnivorous substrate feeders that consume bacteria, algae, fungi, and animal and plant remains; only rarely are amphipods predacious on living animals (**Wetzel, 1983**).

References

Wetzel, R.G. 1983. *Limnology—Second Edition.* Saunders College Publishing, Division of Holt, Rinehart & Winston, Inc., Orlando, FL. ISBN 0-03-057913-9.

Stickney, A.P., and L.D. Stringer. 1957. A study of the Invertebrate Bottom Fauna of Greenwich Bay, Rhode Island. *Ecology 38:111-112.*

Mills, E.L. 1964. *Ampelisca abdita*, a New Amphipod Crustacean Sibling Species Pair. *J. Fish. Res. Bd. Can. 24:305-355.*

ECHINODERM
(*Dendraster excentricus*)

Habitat and Distribution

The sand dollar, *Dendraster excentricus* occurs in dense clumps or aggregations of up to several hundred individuals per square meter in sandy, shallow-water subtidal or intertidal habitats along the west coast of North America (**Highsmith, 1982**). In the Puget Sound region, records indicate that intertidal sand dollar beds persist at the same location for at least several decades, much longer than the typical maximum 8-9 year life span of individuals. Intertidal *D. excentricus* tends to assume a vertical position during high tide and bury into the sand at low tide. Subtidal *D. excentricus* occurs on outer coast beaches with the location of their shoreward margin usually occurring just seaward of the breaker line (**Highsmith, 1982**).

Spawning and Larvae

D. excentricus grows steadily until its fifth year when its growth rate is grossly reduced: there is no great difference in size distribution between animals from 5 to 8 years of age. The average size of adult *D. excentricus* is about 6-8 centimeters (**Birkeland and Chia, 1971**). Spawning occurs mainly during spring and summer. Larvae are capable of metamorphosis (after a specified developmental period) and when presented with various substrates show a significant preference for adult-associated sand. Larvae settlement occurs within or adjacent to existing sand dollar beds often containing several hundred per square meter. *D. excentricus* appears to be fairly immune to predation although evidence indicates that juvenile mortality can be attributed primarily to predation by two gammarid amphipods (*Leptosynapta clarkii* and *Leptochelia dubia*). Gregarious behavior by *D. excentricus*, as evidenced through high densities of individuals, appears to have more advantages than disadvantages by primarily reducing predation (**Birkeland and Chia, 1971**).

Feeding Behavior

D. excentricus is a detritus or mud suspension feeder (**Wetzel, 1983**). The major sources of food for *D. excentricus* include diatoms, green algae, and detritus (**Chia, 1969**).

References

Birkeland, C., and F.S. Chia. 1971. Recruitment Risk, Growth, Age, and Predation in Two Populations of Sand Dollars, *Dendraster excentricus* (Eschscholtz*). J. Exp. Mar. Biol. Ecol. 6:265-278.*

Wetzel, R.G. 1983. *Limnology—Second Edition.* Saunders College Publishing, Division of Holt, Rinehart & Winston, Inc., Orlando, FL. ISBN 0-03-057913-9.

Chia, F.S. 1969. Some Observations on the Locomotion and Feeding of the Sand Dollar, *Dendraster excentricus* (Eschscholtz). *J. Exp. Mar. Biol. Ecol. 3:162-170.*

Highsmith, R.C. 1982. Induced Settlement and Metamorphosis of Sand Dollar (*Dendraster excentricus*) Larvae in Predator Free Sites: Adult Sand Dollar Beds. *Ecology 63:329-337.*

ATTACHMENT K.3

ECOLOGICAL RISK CALCULATIONS

Attachment K.3—Ecological Risk Calculations

PCB Effects (µg/kg-ww)

Egg/Fry	Juvenile/Adult
330	600

TCDD Effects (ng/kg-ww)

Egg/Fry	Juvenile/Adult
34	314

Whole Body Fish Tissue Concentrations

TCDD(ng/kg-ww)	PCBs(µg/kg-ww)	Transect/Station ID	HQ-TCDD	HQ-PCB
0.120	289	FT2-NORTH-ES	0.000	0.48
0.040	216		0.000	0.36
0.020	119		0.000	0.20
0.060	***208***		***0.000***	***0.35***
3.030	127	FT2-WEST-ES	0.010	0.21
0.650	302		0.002	0.50
0.120	205		0.000	0.34
1.267	***211.33***		***0.004***	***0.35***

Egg Tissue Concentrations (assuming wet weight MTRANS)

TCDD (ng/kg-ww)	PCBs(µg/kg-ww)	Transect/Station ID	HQ-TCDD	HQ-PCB
0.060	36.99	FT2-NORTH-ES	0.002	0.11
0.020	27.65		0.001	0.08
0.010	15.23		0.000	0.05
0.030	***26.62***		***0.001***	***0.08***
1.520	16.26	FT2-WEST-ES	0.045	0.05
0.330	38.66		0.010	0.12
0.060	26.24		0.002	0.08
0.637	***27.05***		***0.019***	***0.08***

Egg Tissue Concentrations (assuming lipid-based MTRANS)

TCDD (ng/kg-ww)	PCBs(µg/kg-ww)	Transect/Station ID	HQ-TCDD	HQ-PCB
0.265	163	FT2-NORTH-ES	0.008	0.50
0.056	78		0.002	0.24
0.035	54		0.001	0.16
0.119	***98.19***		***0.003***	***0.30***
7.048	76	FT2-WEST-ES	0.207	0.23
0.737	88		0.022	0.27
0.153	67		0.004	0.20
2.646	***76.71***		***0.078***	***0.23***

Attachment K.3—Summary of Egg Tissue Concentration Data

Transect/Station ID	Whole Body Fish Tissues: PCBs (µg/kg-ww)	TCDD (ng/kg-ww)	% Fish Lipid	PCBs (µg/kg LIPN)	TCDD (ng/kg LIPN)	Egg Tissues: PCBs (µg/kg-LPN)	TCDD (ng/kg-LPN)	% Egg Lipid	PCBs (µg/kg-ww)	TCDD (µg/kg-ww)
FT2-N-ES-W										
NORTH-ES-WB-R1	289	0.12	2.2	13136	5.45	1681	2.73	9.72	163	0.26
NORTH-ES-WB-R2	216	0.04	3.3	6545	1.21	838	0.61	9.27	78	0.06
NORTH-ES-WB-R3	119	0.02	2.7	4407	0.74	564	0.37	9.49	54	0.04
FT2-W-ES-W										
WEST-ES-WB-R2	127	3.03	2.1	6048	144.29	774	72.14	9.77	76	7.05
WEST-ES-WB-R4	302	0.65	4	7550	16.25	966	8.13	9.07	88	0.74
WEST-ES-WB-R5	205	0.12	3.6	5694	3.33	729	1.67	9.18	67	0.15

Wet Weight Egg Tissue Concentrations: EGG = MTRANS*FSH/%LIPID
Lipid Normalized Egg Tissue Concentrations: EGG = MTRANS*FSH

Attachment K.3—Calculating Percent of Total Lipid for Marine Sediments Unit

Percent of Total Lipid in Fish Eggs

Sample ID	Total Fish Weight[a] (g)	% Lipid in Whole Body Fish Tissue[b]	Lipid Weight (g) in Whole Body Fish Tissue	% of Total Fish Lipid in Egg Tissue[c]	Lipid in Egg Tissues (g)	Egg Weight as a % of Total Weight[d]	Egg Weight (g)	% Egg Lipid
FT2-NORTH-ES-WB-R1	110	2.2	2.42	61.2	1.48	13.86	15.25	9.72
FT2-NORTH-ES-WB-R2	90	3.3	2.97	38.9	1.16	13.86	12.47	9.27
FT2-NORTH-ES-WB-R3	100	2.7	2.7	48.7	1.32	13.86	13.86	9.49
FT2-WEST-ES-WB-R2	110	2.1	2.31	64.5	1.49	13.86	15.25	9.77
FT2-WEST-ES-WB-R4	120	4	4.8	31.4	1.51	13.86	16.63	9.07
FT2-WEST-ES-WB-R5	130	3.6	4.68	35.3	1.65	13.86	18.02	9.18

[a] Fish weight based on average whole body weight of English sole from trawl that were retained for analysis

[b] % Lipid in fish tissue is based on the whole body composite from each replicate trawl.

[c] % Lipid in egg tissues is based on the Niimi (1983) lipid regression equation (log Y = 2.169 - 1.116 log X)

[d] Egg weight based on average percent of egg weight versus whole body weight from 5 freshwater species studied by Niimi (1983)

ATTACHMENT K.4

BENTHIC ENDPOINT DERIVATION PROCEDURES AND STATISTICAL METHODS

ATTACHMENT K.4

BENTHIC ENDPOINT DERIVATION PROCEDURES AND STATISTICAL METHODS

INTRODUCTION

This attachment describes the statistical methods used for evaluating the laboratory bioassay and benthic infaunal data, as well as the methods for deriving the benthic endpoints evaluated in the risk assessment. The benthic evaluations included the derivation of multiple endpoints and classification analyses; the statistical analyses included the use of hypothesis testing (i.e., parametric and non-parametric pair-wise and multiple comparison tests) and correlation analysis.

DERIVATION OF BENTHIC ENDPOINTS

Abundance

Abundance was represented as a measure of density and was set equal to the total number of individuals per sample area. For each station, total abundance (# individuals/0.5m^2) was derived by summing the total number of individuals collected in all five replicates; major taxa group total abundances were similarly derived by summing the number of individuals collected in all five replicates within each taxonomic group (i.e., crustaceans, molluscs, polychaetes, and miscellaneous taxa). Average station total abundance and major taxa group abundances (# individuals/0.1m^2) were derived by averaging the number of individuals present in each replicate sample.

Richness

Richness was defined as the number of taxa per sample area. For each station, total richness (# taxa/0.5 m^2) was derived by summing the number of unique species or taxa collected at the given location. Average station richness (# taxa/0.1 m^2) was derived by averaging the number of unique species or taxa present in each replicate sample. Major taxonomic group total and average richness values were similarly derived.

SDI

Swartz's Dominance Index (SDI) (**Swartz et al., 1985**) is the number (or fraction) of taxa that account for 75 percent of the total abundance. The abundances of individual taxa are ranked from greatest to least prior to calculating the index so that the resulting value reflects the number of numerically abundant taxa in the sample. **Swartz et al. (1985)** demonstrated that this index is useful for describing community structure, and that it is statistically testable. Furthermore, it does not assume an underlying distribution of individuals among taxa. For the purposes of the risk assessment, the SDI values were calculated on a station, rather than replicate, basis, as statistical testing of this endpoint was not conducted.

CLASSIFICATION (CLUSTER) ANALYSIS

Classification (cluster) analysis identifies groupings in a data set. Using species abundance data, the cluster analysis identifies "homogenous groups" (clusters) of sampling locations based on similar species composition and abundance. The classification analysis was conducted using the Bray-Curtis proportional similarity index with a group-averaging cluster algorithm. Before the analysis was conducted, the data matrix was reduced to 214 taxa by dropping any taxa with less than 9 individuals in the entire data set to meet software maximum matrix size limitations. Data were log(x+1)-transformed to minimize the effect of numerically dominant taxa.

PARAMETRIC PAIR-WISE AND MULTIPLE-COMPARISON TESTING

Amphipod Laboratory Toxicity Data

The statistical evaluations of the amphipod mortality data were based on both simple pair-wise and multiple-comparison tests. In accordance with the SMS, independent t-tests were conducted for the two-sample comparisons to determine whether statistically significant differences existed between Marine Sediments Unit and reference organism responses. However, because of reference performance failures in the amphipod bioassay, control responses were used in the comparison tests. The independent t-test procedure is based on the assumption that the data are approximately normally distributed, but does not assume that the samples have equal variances. To satisfy the normality assumption, the amphipod mortality percentile data were transformed using an arcsin-square root transformation, which better approximates a normal distribution, and these transformed data were used in the statistical comparisons. An alpha or probability level of $P \leq 0.05$ was used as the significance level for the t-test, in accordance with the SMS; critical values less than this level were considered significantly different. All t-tests were conducted using the statistical package SYSTAT (1994, Version 6.0 for DOS). Because SYSTAT only provides two-tailed probabilities for the independent paired t-test, the resulting critical values were divided in half to obtain one-tailed probability results.

Multiple-comparison ANOVAs with Dunnett's *a posteriori* pair-wise test were also conducted to further evaluate the statistical significance of the test results. Dunnett's procedure allows the identification of samples representing control or reference, so that samples are only compared to the control set and not all other stations. This statistical approach more closely reflects the sampling design developed for evaluating risk. A P-level of 0.10 was used to ensure a pair-wise Type I error rate comparable to the t-test and a subsequent preservation of power (i.e., the ability to detect a true difference). Transformed data were used in the ANOVAs, and the tests were conducted using the statistical package SYSTAT (1994, Version 6.0 for DOS).

Benthic Abundance and Richness Data

The statistical evaluations of the benthic abundance and richness data, including comparisons of total abundance and richness and major taxonomic group abundance and richness with reference, were also based on both simple pair-wise and multiple-comparison tests, and generally followed the procedures described above. Differences were as follows:

- Benthic abundance data tend to be log-normally distributed and thus were transformed using a $\log_{10}(x+1)$ transformation; these transformed data were used in the statistical comparisons.

- Benthic richness data tend to be normally distributed and thus were not transformed prior to statistical testing.

- P-levels were set at 0.10 for both the t-tests and the ANOVAs with Dunnett's *a posteriori* test.

ANOVAs using Tukey's *a posteriori* test were also conducted using Marine Sediments Unit stations only to determine whether significant differences occurred for any of the possible station pairs. For consistency in interpretation of all ANOVA results, the P-level for these comparisons was also set at 0.10.

Statistical tests were conducted using the statistical package SYSTAT (1994, Version 6.0 for DOS; SPSS, 1996, Version 7.0 for Windows).

NONPARAMETRIC PAIR-WISE AND MULTIPLE-COMPARISON TESTING

Echinoderm Laboratory Bioassay Data

Nonparametric techniques were required for evaluating the echinoderm larval effective mortality data, based on a lack of variance in the control results, which were substituted for reference responses because of reference performance failures. The pair-wise comparisons were conducted using a Mann-Whitney U test procedure, which is the nonparametric equivalent of the t-test, to determine which stations were different from the control. In this nonparametric procedure, the data are assigned ranks, and the test statistic calculated on the ranks rather than the actual responses. For the echinoderm larval effective mortality data, ranks were assigned from lowest to highest (i.e., the numerically lowest response was assigned the lowest rank). The test statistic was calculated using the statistical package SYSTAT (1994; Version 6.0 for DOS). The P-level for the test was set at 0.10, based on recent guidance from Ecology (**1996**).

A multiple-comparison Kruskal-Wallis test, which is the nonparametric equivalent of an ANOVA, was also used to further evaluate the statistical significance of the test results. This test uses a ranking procedure identical to that described for the Mann-Whitney U test. The test statistic was calculated using the statistical package SYSTAT (SPSS, 1996, Version 7.0 for Windows). For consistency in interpretation of test results, the P-level for the test was set at 0.10.

CORRELATION ANALYSIS

Correlation analysis reveals the intensity or strength of a linear relationship between two variables, but involves no assumption of dependency between variables (i.e., both variables have a describable relationship, but are independent of one another). The Pearson correlation coefficient (r) was used as a measure of the strength of the linear association among the variables tested. A correlation coefficient can have a value ranging from 0 to ± 1.00. Values approaching

±1.00 indicate stronger linear relationships; low values indicate a weak association or other than a linear association. To more closely approximate the assumptions of normality required for correlation analyses, transformed data were used in the statistical evaluations.

Correlation results were considered to be ecologically significant when a strong degree of association was observed, which was defined as a correlation coefficient with a value greater than or equal to 0.7 [implying that at least 50 percent of the variation in the one variable could be statistically attributed to the variation in the other variable ($r^2 \geq 0.49$)].

REFERENCES

Swartz, R.C., D.W. Schultz, G.R. Ditsworth, W.A. DeBen, and F.A. Cole. 1985. Sediment toxicity, contamination, and macrobenthic communities near a large sewage outfall. In: Validation and Predictability of Laboratory Methods for Assessing the Fate and Effects of Contaminants in Aquatic Ecosystems. pp. 152-175. T.T. Boyle (ed.) American Society for Testing Materials STP 865. Philadelphia, PA.

SYSTAT. 1994. SYSTAT for DOS, Version 6 Edition. SYSTAT, Inc., Evanston, IL.

SPSS. 1996. SYSTAT for Windows, Version 7.0 Edition. SPSS, Inc., Chicago, IL.

ATTACHMENT K.5

STATISTICAL OUTPUTS SUPPORTING BENTHIC RISK CHARACTERIZATION

LABORATORY BIOASSAY

- Amphipod t-test Results
- Amphipod ANOVA Results
- Echinoderm Mann-Whitney U Results
- Echinoderm Kruskal-Wallis Results

Amphipod t-test Results

t-Test Results - Amphipod Mortality - Offshore Unit vs. Control Response

(Note: Probilities are two-tailed; divide by 2 to obtain one-tailed P-value)

Two-sample t test on TMORT grouped by STATION$

Group	N	Mean	SD
CONT	5	0.267	0.172
EB49	5	0.539	0.208

Separate Variance t = -2.261 DF = 7.7 Prob = 0.055
Difference in Means = -0.272 95.00% CI = -0.552 to 0.007

Pooled Variance t = -2.261 DF = 8 Prob = 0.054
Difference in Means = -0.272 95.00% CI = -0.550 to 0.005

Two-sample t test on TMORT grouped by STATION$

Group	N	Mean	SD
CONT	5	0.267	0.172
EB60	5	0.903	0.163

Separate Variance t = -6.017 DF = 8.0 Prob = 0.000
Difference in Means = -0.637 95.00% CI = -0.881 to -0.393

Pooled Variance t = -6.017 DF = 8 Prob = 0.000
Difference in Means = -0.637 95.00% CI = -0.881 to -0.393

Two-sample t test on TMORT grouped by STATION$

Group	N	Mean	SD
CONT	5	0.267	0.172
EB67	5	0.745	0.116

Separate Variance t = -5.174 DF = 7.0 Prob = 0.001
Difference in Means = -0.479 95.00% CI = -0.697 to -0.260

Pooled Variance t = -5.174 DF = 8 Prob = 0.001
Difference in Means = -0.479 95.00% CI = -0.692 to -0.265

Two-sample t test on TMORT grouped by STATION$

Group	N	Mean	SD
CONT	5	0.267	0.172
EB77	5	0.798	0.245

Separate Variance t = -3.978 DF = 7.2 Prob = 0.005
Difference in Means = -0.532 95.00% CI = -0.846 to -0.217

Pooled Variance t = -3.978 DF = 8 Prob = 0.004
Difference in Means = -0.532 95.00% CI = -0.840 to -0.223

Two-sample t test on TMORT grouped by STATION$

Group	N	Mean	SD
CONT	5	0.267	0.172
EB80	5	0.707	0.210

Separate Variance t = -3.628 DF = 7.7 Prob = 0.007
Difference in Means = -0.440 95.00% CI = -0.722 to -0.158

Pooled Variance t = -3.628 DF = 8 Prob = 0.007
Difference in Means = -0.440 95.00% CI = -0.720 to -0.160

Two-sample t test on TMORT grouped by STATION$

Group	N	Mean	SD
CONT	5	0.267	0.172
EB85	5	0.795	0.215

Separate Variance t = -4.296 DF = 7.6 Prob = 0.003
Difference in Means = -0.529 95.00% CI = -0.815 to -0.242

Pooled Variance t = -4.296 DF = 8 Prob = 0.003
Difference in Means = -0.529 95.00% CI = -0.813 to -0.245

Two-sample t test on TMORT grouped by STATION$

```
  Group                N          Mean           SD
    CONT               5         0.267        0.172
    EB87               5         1.017        0.098

     Separate Variance t =        -8.497 DF =      6.4     Prob =         0.000
     Difference in Means =        -0.751    95.00% CI =      -0.964 to      -0.538

       Pooled Variance t =        -8.497 DF =      8       Prob =         0.000
     Difference in Means =        -0.751    95.00% CI =      -0.955 to      -0.547
```

Two-sample t test on TMORT grouped by STATION$

```
  Group                N          Mean           SD
    CONT               5         0.267        0.172
    EB85               5         0.795        0.215

     Separate Variance t =        -4.296 DF =      7.6     Prob =         0.003
     Difference in Means =        -0.529    95.00% CI =      -0.815 to      -0.242

       Pooled Variance t =        -4.296 DF =      8       Prob =         0.003
     Difference in Means =        -0.529    95.00% CI =      -0.813 to      -0.245
```

Two-sample t test on TMORT grouped by STATION$

```
  Group                N          Mean           SD
    CONT               5         0.267        0.172
    EB104              5         0.711        0.153

     Separate Variance t =        -4.326 DF =      7.9     Prob =         0.003
     Difference in Means =        -0.445    95.00% CI =      -0.682 to      -0.207

       Pooled Variance t =        -4.326 DF =      8       Prob =         0.003
     Difference in Means =        -0.445    95.00% CI =      -0.682 to      -0.208
```

Two-sample t test on TMORT grouped by STATION$

```
  Group                N          Mean           SD
    CONT               5         0.267        0.172
    EB106              5         0.641        0.249

     Separate Variance t =        -2.772 DF =      7.1     Prob =         0.027
     Difference in Means =        -0.374    95.00% CI =      -0.693 to      -0.056

       Pooled Variance t =        -2.772 DF =      8       Prob =         0.024
     Difference in Means =        -0.374    95.00% CI =      -0.686 to      -0.063

>
```

Amphipod ANOVA Results

ANOVA Test Results with Dunnett's
Amphipod Mortality (>25%) - Offshore Unit vs. Control

LEVELS ENCOUNTERED DURING PROCESSING ARE:
STATION$

CONT	EB104	EB106	EB49	EB60	EB67
EB77	EB80	EB85	EB87		

ÄÄ

DEP VAR: TMORT N: 50 MULTIPLE R: 0.755 SQUARED MULTIPLE R: 0.570

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
STATION$	1.894	9	0.210	5.880	0.000
ERROR	1.432	40	0.036		

ÄÄ

COL/ ROW	STATION$
1	CONT
2	EB104
3	EB106
4	EB49
5	EB60
6	EB67
7	EB77
8	EB80
9	EB85
10	EB87

USING LEAST SQUARES MEANS.

POST HOC TEST OF TMORT
DUNNETT TEST WITH CONTROL = CONT

ÄÄ
MATRIX OF MEAN DIFFERENCES FROM CONTROL:

1	0.000
2	0.445
3	0.374
4	0.272
5	0.637
6	0.479
7	0.532
8	0.440
9	0.529
10	0.751

DUNNETT ONE SIDED TEST.

MATRIX OF PAIRWISE COMPARISON PROBABILITIES:

1	1.000
2	0.002
3	0.011
4	0.080
5	0.000
6	0.001
7	0.000
8	0.003
9	0.000
10	0.000

ÄÄ

ANOVA Test Results with Dunnett's
Amphipod Mortality (>30% + Control) - Offshore Unit vs. Control

```
LEVELS ENCOUNTERED DURING PROCESSING ARE:
STATION$
 CONT          EB104        EB60         EB67         EB77         EB80
 EB85          EB87
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ


DEP VAR:   TMORT      N:      40  MULTIPLE R: 0.790  SQUARED MULTIPLE R: 0.624

                         ANALYSIS OF VARIANCE

SOURCE        SUM-OF-SQUARES   DF  MEAN-SQUARE     F-RATIO       P

STATION$               1.681    7        0.240       7.596       0.000

ERROR                  1.011   32        0.032

ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
COL/
ROW STATION$
  1  CONT
  2  EB104
  3  EB60
  4  EB67
  5  EB77
  6  EB80
  7  EB85
  8  EB87

USING LEAST SQUARES MEANS.

POST HOC TEST OF    TMORT
DUNNETT TEST WITH CONTROL = CONT

ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

MATRIX OF MEAN DIFFERENCES FROM CONTROL:


             1         0.000
             2         0.445
             3         0.637
             4         0.479
             5         0.532
             6         0.440
             7         0.529
             8         0.751


DUNNETT ONE SIDED TEST.
MATRIX OF PAIRWISE COMPARISON PROBABILITIES:


             1         1.000
             2         0.001
             3         0.000
             4         0.001
             5         0.000
             6         0.001
             7         0.000
             8         0.000


ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

>
```

Echinoderm Mann-Whitney U Results

Mann-Whitney U Test Results - Echinoderm Effective Mortality - Offshore Unit vs. Control

```
Categorical values encountered during processing are:
STATION$ (2 levels)
   CONT, EB49

Kruskal-Wallis One-Way Analysis of Variance for 20 cases
Dependent variable is PMORT
 Grouping variable is STATION$

    Group      Count    Rank Sum

  CONT           10       85.00
  EB49           10      125.00
Mann-Whitney U test statistic =       30.000
Probability is        0.031
Chi-square approximation =        4.677 with 1 DF

Categorical values encountered during processing are:
STATION$ (2 levels)
   CONT, EB60

Kruskal-Wallis One-Way Analysis of Variance for 20 cases
Dependent variable is PMORT
 Grouping variable is STATION$

    Group      Count    Rank Sum

  CONT           10       75.00
  EB60           10      135.00
Mann-Whitney U test statistic =       20.000
Probability is        0.005
Chi-square approximation =        7.817 with 1 DF

Categorical values encountered during processing are:
STATION$ (2 levels)
   CONT, EB67

Kruskal-Wallis One-Way Analysis of Variance for 20 cases
Dependent variable is PMORT
 Grouping variable is STATION$

    Group      Count    Rank Sum

  CONT           10       55.00
  EB67           10      155.00
Mann-Whitney U test statistic =        0.0
Probability is        0.000
Chi-square approximation =       16.323 with 1 DF

Categorical values encountered during processing are:
STATION$ (2 levels)
   CONT, EB77

Kruskal-Wallis One-Way Analysis of Variance for 20 cases
Dependent variable is PMORT
 Grouping variable is STATION$

    Group      Count    Rank Sum

  CONT           10       75.00
  EB77           10      135.00
Mann-Whitney U test statistic =       20.000
Probability is        0.005
Chi-square approximation =        7.826 with 1 DF

Categorical values encountered during processing are:
STATION$ (2 levels)
   CONT, EB80

Kruskal-Wallis One-Way Analysis of Variance for 20 cases
Dependent variable is PMORT
 Grouping variable is STATION$

    Group      Count    Rank Sum

  CONT           10       65.00
  EB80           10      145.00
```

```
Mann-Whitney U test statistic =        10.000
Probability is         0.001
Chi-square approximation =       11.659 with 1 DF

Categorical values encountered during processing are:
STATION$ (2 levels)
   CONT, EB85

Kruskal-Wallis One-Way Analysis of Variance for 20 cases
Dependent variable is PMORT
 Grouping variable is STATION$

    Group       Count    Rank Sum

  CONT            10        60.00
  EB85            10       150.00
Mann-Whitney U test statistic =        5.000
Probability is         0.000
Chi-square approximation =       13.865 with 1 DF

Categorical values encountered during processing are:
STATION$ (2 levels)
   CONT, EB87

Kruskal-Wallis One-Way Analysis of Variance for 20 cases
Dependent variable is PMORT
 Grouping variable is STATION$

    Group       Count    Rank Sum

  CONT            10        55.00
  EB87            10       155.00
Mann-Whitney U test statistic =        0.0
Probability is         0.000
Chi-square approximation =       16.323 with 1 DF

Categorical values encountered during processing are:
STATION$ (2 levels)
   CONT, EB104

Kruskal-Wallis One-Way Analysis of Variance for 20 cases
Dependent variable is PMORT
 Grouping variable is STATION$

    Group       Count    Rank Sum

  CONT            10        55.00
  EB104           10       155.00
Mann-Whitney U test statistic =        0.0
Probability is         0.000
Chi-square approximation =       16.309 with 1 DF

Categorical values encountered during processing are:
STATION$ (2 levels)
   CONT, EB106

Kruskal-Wallis One-Way Analysis of Variance for 20 cases
Dependent variable is PMORT
 Grouping variable is STATION$

    Group       Count    Rank Sum

  CONT            10        60.00
  EB106           10       150.00
Mann-Whitney U test statistic =        5.000
Probability is         0.000
Chi-square approximation =       13.865 with 1 DF

>
```

Echinoderm Kruskal-Wallis Results

Kruskal-Wallis ANOVA Results - Echinoderm Effective Mortality - Offshore Unit vs. Control

Categorical values encountered during processing are:
STATION$ (10 levels)
BK04A, EB104, EB106, EB49, EB60, EB67, EB77, EB80, EB85, EB87

Kruskal-Wallis One-Way Analysis of Variance for 100 cases
Dependent variable is PMORT
Grouping variable is STATION$

Group	Count	Rank Sum
BK04A	10	923.500
EB104	10	795.000
EB106	10	352.000
EB49	10	245.000
EB60	10	267.000
EB67	10	509.000
EB77	10	304.000
EB80	10	424.500
EB85	10	560.000
EB87	10	670.000

Kruskal-Wallis Test Statistic = 57.857
Probability is 0.000 assuming Chi-square distribution with 9 df

>

>

BENTHOS

- Descriptive Statistics
- t-test Results (versus Reference)
- ANOVA with Dunnett's (versus Reference)
- ANOVA with Tukey's (among Unit samples)
- Summary ANOVA Results for Benthic Comparisons
- Bray-Curtis Classification Analysis

Descriptive Statistics

Descriptive Statistical Data - Benthos

The following results are for:
STATION$ = EB49

	TCRSTAB	TMISCAB	TMOLLAB	TPOLYAB	TABUND
N of cases	5	5	5	5	5
Minimum	71.000	8.000	405.000	208.000	805.000
Maximum	174.000	36.000	644.000	385.000	1041.000
Median	116.000	27.000	516.000	226.000	868.000
Mean	123.800	26.600	510.600	257.200	918.200
95% CI Upper	174.514	40.554	633.282	349.190	1049.198
95% CI Lower	73.086	12.646	387.918	165.210	787.202
Std. Error	18.266	5.026	44.187	33.132	47.182
Standard Dev	40.844	11.238	98.804	74.086	105.502
C.V.	0.330	0.422	0.194	0.288	0.115

	TRICH
N of cases	5
Minimum	82.000
Maximum	104.000
Median	85.000
Mean	88.400
95% CI Upper	99.457
95% CI Lower	77.343
Std. Error	3.982
Standard Dev	8.905
C.V.	0.101

The following results are for:
STATION$ = EB60

	TCRSTAB	TMISCAB	TMOLLAB	TPOLYAB	TABUND
N of cases	5	5	5	5	5
Minimum	212.000	27.000	749.000	180.000	1283.000
Maximum	340.000	68.000	1120.000	361.000	1756.000
Median	276.000	45.000	851.000	318.000	1535.000
Mean	280.600	46.200	883.200	280.800	1490.800
95% CI Upper	338.744	65.141	1056.712	383.241	1726.000
95% CI Lower	222.456	27.259	709.688	178.359	1255.600
Std. Error	20.942	6.822	62.494	36.896	84.713
Standard Dev	46.827	15.255	139.742	82.503	189.423
C.V.	0.167	0.330	0.158	0.294	0.127

	TRICH
N of cases	5
Minimum	71.000
Maximum	91.000
Median	89.000
Mean	85.000
95% CI Upper	95.277
95% CI Lower	74.723
Std. Error	3.701
Standard Dev	8.276
C.V.	0.097

The following results are for:
STATION$ = EB67

	TCRSTAB	TMISCAB	TMOLLAB	TPOLYAB	TABUND
N of cases	5	5	5	5	5
Minimum	118.000	23.000	450.000	180.000	771.000
Maximum	321.000	52.000	906.000	318.000	1554.000
Median	232.000	44.000	489.000	194.000	1099.000
Mean	221.800	38.800	611.800	222.800	1095.200
95% CI Upper	328.815	53.992	858.667	296.060	1476.738
95% CI Lower	114.785	23.608	364.933	149.540	713.662
Std. Error	38.544	5.472	88.915	26.386	137.420
Standard Dev	86.187	12.235	198.820	59.002	307.280
C.V.	0.389	0.315	0.325	0.265	0.281

	TRICH
N of cases	5
Minimum	67.000
Maximum	100.000
Median	81.000

Mean	81.800
95% CI Upper	96.580
95% CI Lower	67.020
Std. Error	5.324
Standard Dev	11.904
C.V.	0.146

The following results are for:
STATION$ = EB77

	TCRSTAB	TMISCAB	TMOLLAB	TPOLYAB	TABUND
N of cases	5	5	5	5	5
Minimum	174.000	5.000	380.000	280.000	847.000
Maximum	430.000	19.000	715.000	394.000	1479.000
Median	397.000	13.000	576.000	332.000	1349.000
Mean	353.200	13.000	564.000	333.400	1263.600
95% CI Upper	485.783	19.801	725.686	386.456	1571.500
95% CI Lower	220.617	6.199	402.314	280.344	955.700
Std. Error	47.753	2.449	58.235	19.109	110.897
Standard Dev	106.779	5.477	130.217	42.729	247.973
C.V.	0.302	0.421	0.231	0.128	0.196

	TRICH
N of cases	5
Minimum	82.000
Maximum	103.000
Median	84.000
Mean	88.600
95% CI Upper	99.517
95% CI Lower	77.683
Std. Error	3.932
Standard Dev	8.792
C.V.	0.099

The following results are for:
STATION$ = EB80

	TCRSTAB	TMISCAB	TMOLLAB	TPOLYAB	TABUND
N of cases	5	5	5	5	5
Minimum	129.000	6.000	239.000	147.000	546.000
Maximum	265.000	31.000	1014.000	259.000	1497.000
Median	190.000	15.000	873.000	232.000	1311.000
Mean	194.600	18.000	763.400	216.400	1192.400
95% CI Upper	259.432	30.354	1139.367	275.249	1661.791
95% CI Lower	129.768	5.646	387.433	157.551	723.009
Std. Error	23.351	4.450	135.413	21.196	169.062
Standard Dev	52.214	9.950	302.793	47.395	378.034
C.V.	0.268	0.553	0.397	0.219	0.317

	TRICH
N of cases	5
Minimum	72.000
Maximum	84.000
Median	77.000
Mean	76.600
95% CI Upper	82.783
95% CI Lower	70.417
Std. Error	2.227
Standard Dev	4.980
C.V.	0.065

The following results are for:
STATION$ = EB85

	TCRSTAB	TMISCAB	TMOLLAB	TPOLYAB	TABUND
N of cases	5	5	5	5	5
Minimum	247.000	10.000	550.000	165.000	977.000
Maximum	378.000	25.000	1115.000	341.000	1848.000
Median	303.000	15.000	944.000	238.000	1547.000
Mean	305.400	17.400	900.600	244.200	1467.600
95% CI Upper	364.523	25.282	1167.951	330.580	1866.568
95% CI Lower	246.277	9.518	633.249	157.820	1068.632
Std. Error	21.295	2.839	96.293	31.112	143.697
Standard Dev	47.616	6.348	215.317	69.568	321.317
C.V.	0.156	0.365	0.239	0.285	0.219

TRICH

N of cases	5
Minimum	68.000
Maximum	100.000
Median	93.000
Mean	85.800
95% CI Upper	104.577
95% CI Lower	67.023
Std. Error	6.763
Standard Dev	15.123
C.V.	0.176

The following results are for:
STATION$ = EB87

	TCRSTAB	TMISCAB	TMOLLAB	TPOLYAB	TABUND
N of cases	5	5	5	5	5
Minimum	156.000	9.000	236.000	537.000	1065.000
Maximum	309.000	36.000	325.000	766.000	1320.000
Median	251.000	14.000	276.000	658.000	1185.000
Mean	250.000	16.800	281.000	654.000	1201.800
95% CI Upper	322.065	30.498	324.396	760.396	1322.111
95% CI Lower	177.935	3.102	237.604	547.604	1081.489
Std. Error	25.956	4.934	15.630	38.321	43.333
Standard Dev	58.039	11.032	34.950	85.688	96.895
C.V.	0.232	0.657	0.124	0.131	0.081

	TRICH
N of cases	5
Minimum	106.000
Maximum	122.000
Median	109.000
Mean	111.600
95% CI Upper	119.284
95% CI Lower	103.916
Std. Error	2.768
Standard Dev	6.189
C.V.	0.055

The following results are for:
STATION$ = EB104

	TCRSTAB	TMISCAB	TMOLLAB	TPOLYAB	TABUND
N of cases	5	5	5	5	5
Minimum	235.000	16.000	343.000	330.000	1055.000
Maximum	379.000	41.000	1073.000	544.000	1813.000
Median	284.000	31.000	492.000	475.000	1272.000
Mean	291.600	29.000	599.400	437.200	1357.200
95% CI Upper	357.686	41.070	956.426	548.033	1715.630
95% CI Lower	225.514	16.930	242.374	326.367	998.770
Std. Error	23.803	4.347	128.591	39.919	129.097
Standard Dev	53.224	9.721	287.538	89.262	288.669
C.V.	0.183	0.335	0.480	0.204	0.213

	TRICH
N of cases	5
Minimum	101.000
Maximum	119.000
Median	113.000
Mean	111.000
95% CI Upper	121.681
95% CI Lower	100.319
Std. Error	3.847
Standard Dev	8.602
C.V.	0.077

The following results are for:
STATION$ = EB106

	TCRSTAB	TMISCAB	TMOLLAB	TPOLYAB	TABUND
N of cases	5	5	5	5	5
Minimum	101.000	5.000	225.000	219.000	621.000
Maximum	136.000	56.000	414.000	344.000	797.000
Median	105.000	39.000	268.000	253.000	747.000
Mean	113.600	33.200	304.000	278.600	729.400
95% CI Upper	132.586	57.331	406.882	350.951	813.273
95% CI Lower	94.614	9.069	201.118	206.249	645.527
Std. Error	6.838	8.691	37.055	26.059	30.209

Standard Dev	15.291	19.435	82.858	58.269	67.549
C.V.	0.135	0.585	0.273	0.209	0.093

	TRICH
N of cases	5
Minimum	80.000
Maximum	92.000
Median	82.000
Mean	84.200
95% CI Upper	90.308
95% CI Lower	78.092
Std. Error	2.200
Standard Dev	4.919
C.V.	0.058

The following results are for:
STATION$ = BK04A

	TCRSTAB	TMISCAB	TMOLLAB	TPOLYAB	TABUND
N of cases	5	5	5	5	5
Minimum	95.000	8.000	233.000	216.000	638.000
Maximum	155.000	124.000	327.000	282.000	845.000
Median	134.000	63.000	247.000	271.000	707.000
Mean	130.800	67.000	271.800	256.400	726.000
95% CI Upper	159.079	121.591	326.612	291.040	822.698
95% CI Lower	102.521	12.409	216.988	221.760	629.302
Std. Error	10.185	19.662	19.742	12.476	34.828
Standard Dev	22.775	43.966	44.144	27.898	77.878
C.V.	0.174	0.656	0.162	0.109	0.107

	TRICH
N of cases	5
Minimum	73.000
Maximum	96.000
Median	90.000
Mean	88.200
95% CI Upper	99.457
95% CI Lower	76.943
Std. Error	4.055
Standard Dev	9.066
C.V.	0.103

The following results are for:
STATION$ = BK01M

	TCRSTAB	TMISCAB	TMOLLAB	TPOLYAB	TABUND
N of cases	5	5	5	5	5
Minimum	24.000	196.000	108.000	244.000	727.000
Maximum	53.000	396.000	204.000	492.000	899.000
Median	39.000	223.000	134.000	368.000	772.000
Mean	40.400	250.800	144.800	368.800	804.800
95% CI Upper	53.934	354.050	189.201	490.924	908.106
95% CI Lower	26.866	147.550	100.399	246.676	701.494
Std. Error	4.874	37.188	15.992	43.986	37.208
Standard Dev	10.900	83.155	35.759	98.355	83.200
C.V.	0.270	0.332	0.247	0.267	0.103

	TRICH
N of cases	5
Minimum	113.000
Maximum	142.000
Median	136.000
Mean	132.400
95% CI Upper	147.107
95% CI Lower	117.693
Std. Error	5.297
Standard Dev	11.845
C.V.	0.089

>

The following results are for:
STATION$ = EB49

	TCRSTRC	TMISCRC	TMOLLRC	TPOLYRC
N of cases	5	5	5	5
Minimum	7.000	5.000	18.000	45.000
Maximum	13.000	10.000	24.000	62.000
Median	9.000	8.000	19.000	48.000
Mean	9.800	7.600	20.000	51.000
95% CI Upper	13.014	9.856	22.912	59.467
95% CI Lower	6.586	5.344	17.088	42.533
Std. Error	1.158	0.812	1.049	3.050
Standard Dev	2.588	1.817	2.345	6.819
C.V.	0.264	0.239	0.117	0.134

The following results are for:
STATION$ = EB60

	TCRSTRC	TMISCRC	TMOLLRC	TPOLYRC
N of cases	5	5	5	5
Minimum	8.000	5.000	19.000	34.000
Maximum	13.000	7.000	23.000	56.000
Median	11.000	5.000	22.000	49.000
Mean	10.400	5.600	21.200	47.800
95% CI Upper	13.259	6.711	23.240	58.016
95% CI Lower	7.541	4.489	19.160	37.584
Std. Error	1.030	0.400	0.735	3.680
Standard Dev	2.302	0.894	1.643	8.228
C.V.	0.221	0.160	0.078	0.172

The following results are for:
STATION$ = EB67

	TCRSTRC	TMISCRC	TMOLLRC	TPOLYRC
N of cases	5	5	5	5
Minimum	8.000	5.000	16.000	37.000
Maximum	22.000	6.000	22.000	56.000
Median	12.000	6.000	17.000	45.000
Mean	13.600	5.800	18.000	44.400
95% CI Upper	20.872	6.355	20.912	53.881
95% CI Lower	6.328	5.245	15.088	34.919
Std. Error	2.619	0.200	1.049	3.415
Standard Dev	5.857	0.447	2.345	7.635
C.V.	0.431	0.077	0.130	0.172

The following results are for:
STATION$ = EB77

	TCRSTRC	TMISCRC	TMOLLRC	TPOLYRC
N of cases	5	5	5	5
Minimum	9.000	1.000	14.000	47.000
Maximum	16.000	5.000	25.000	58.000
Median	12.000	4.000	21.000	53.000
Mean	12.200	3.600	19.800	53.000
95% CI Upper	15.756	5.483	24.874	58.757
95% CI Lower	8.644	1.717	14.726	47.243
Std. Error	1.281	0.678	1.828	2.074
Standard Dev	2.864	1.517	4.087	4.637
C.V.	0.235	0.421	0.206	0.087

The following results are for:
STATION$ = EB80

	TCRSTRC	TMISCRC	TMOLLRC	TPOLYRC
N of cases	5	5	5	5
Minimum	9.000	3.000	14.000	39.000
Maximum	15.000	9.000	20.000	47.000
Median	14.000	4.000	16.000	42.000
Mean	12.600	5.000	16.600	42.400
95% CI Upper	15.717	7.912	20.068	46.385
95% CI Lower	9.483	2.088	13.132	38.415
Std. Error	1.122	1.049	1.249	1.435
Standard Dev	2.510	2.345	2.793	3.209
C.V.	0.199	0.469	0.168	0.076

The following results are for:
STATION$ = EB85

	TCRSTRC	TMISCRC	TMOLLRC	TPOLYRC
N of cases	5	5	5	5
Minimum	11.000	4.000	18.000	34.000
Maximum	25.000	5.000	20.000	56.000
Median	15.000	5.000	19.000	50.000
Mean	16.600	4.600	19.000	45.600
95% CI Upper	23.028	5.280	20.242	58.462
95% CI Lower	10.172	3.920	17.758	32.738
Std. Error	2.315	0.245	0.447	4.632
Standard Dev	5.177	0.548	1.000	10.359
C.V.	0.312	0.119	0.053	0.227

The following results are for:
STATION$ = EB87

	TCRSTRC	TMISCRC	TMOLLRC	TPOLYRC
N of cases	5	5	5	5
Minimum	13.000	5.000	16.000	61.000
Maximum	27.000	7.000	21.000	72.000
Median	20.000	6.000	18.000	65.000
Mean	20.200	6.200	18.600	66.600
95% CI Upper	26.371	7.239	21.020	72.463
95% CI Lower	14.029	5.161	16.180	60.737
Std. Error	2.223	0.374	0.872	2.112
Standard Dev	4.970	0.837	1.949	4.722
C.V.	0.246	0.135	0.105	0.071

The following results are for:
STATION$ = EB104

	TCRSTRC	TMISCRC	TMOLLRC	TPOLYRC
N of cases	5	5	5	5
Minimum	16.000	3.000	19.000	56.000
Maximum	31.000	6.000	24.000	68.000
Median	19.000	5.000	21.000	65.000
Mean	22.000	4.800	20.800	63.400
95% CI Upper	29.804	6.160	23.345	69.197
95% CI Lower	14.196	3.440	18.255	57.603
Std. Error	2.811	0.490	0.917	2.088
Standard Dev	6.285	1.095	2.049	4.669
C.V.	0.286	0.228	0.099	0.074

The following results are for:
STATION$ = EB106

	TCRSTRC	TMISCRC	TMOLLRC	TPOLYRC
N of cases	5	5	5	5
Minimum	12.000	2.000	17.000	40.000
Maximum	16.000	10.000	19.000	52.000
Median	14.000	8.000	18.000	43.000
Mean	14.200	7.200	18.000	44.800
95% CI Upper	16.042	11.355	18.878	50.716
95% CI Lower	12.358	3.045	17.122	38.884
Std. Error	0.663	1.497	0.316	2.131
Standard Dev	1.483	3.347	0.707	4.764
C.V.	0.104	0.465	0.039	0.106

The following results are for:
STATION$ = BK04A

	TCRSTRC	TMISCRC	TMOLLRC	TPOLYRC
N of cases	5	5	5	5
Minimum	11.000	4.000	19.000	38.000
Maximum	18.000	7.000	28.000	52.000
Median	14.000	6.000	21.000	49.000
Mean	14.000	5.800	22.000	46.400
95% CI Upper	17.166	7.419	26.301	53.565
95% CI Lower	10.834	4.181	17.699	39.235
Std. Error	1.140	0.583	1.549	2.581
Standard Dev	2.550	1.304	3.464	5.771
C.V.	0.182	0.225	0.157	0.124

```
The following results are for:
   STATION$      = BK01M
```

	TCRSTRC	TMISCRC	TMOLLRC	TPOLYRC
N of cases	5	5	5	5
Minimum	13.000	11.000	21.000	64.000
Maximum	23.000	15.000	31.000	83.000
Median	17.000	14.000	25.000	75.000
Mean	18.200	13.800	25.400	75.000
95% CI Upper	23.424	15.840	30.177	83.824
95% CI Lower	12.976	11.760	20.623	66.176
Std. Error	1.881	0.735	1.720	3.178
Standard Dev	4.207	1.643	3.847	7.106
C.V.	0.231	0.119	0.151	0.095

>

t-test Results

t-Test Results - Benthos Abundance and Richness - Offshore Unit vs. BK04

Two-sample t test on LCRSTAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.114	0.081
EB49	5	2.076	0.152

Separate Variance t =	0.497	DF = 6.1	Prob =	0.637		
		Bonferroni Adjusted Prob =		1.000		
Difference in Means =	0.038	95.00% CI =	-0.149	to	0.225	
Pooled Variance t =	0.497	DF = 8	Prob =	0.633		
		Bonferroni Adjusted Prob =		1.000		
Difference in Means =	0.038	95.00% CI =	-0.139	to	0.215	

Two-sample t test on LMOLLAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.431	0.069
EB49	5	2.702	0.084

Separate Variance t =	-5.588	DF = 7.7	Prob =	0.001		
		Bonferroni Adjusted Prob =		0.004		
Difference in Means =	-0.271	95.00% CI =	-0.384	to	-0.158	
Pooled Variance t =	-5.588	DF = 8	Prob =	0.001		
		Bonferroni Adjusted Prob =		0.003		
Difference in Means =	-0.271	95.00% CI =	-0.383	to	-0.159	

Two-sample t test on LPOLYAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.408	0.049
EB49	5	2.400	0.111

Separate Variance t =	0.162	DF = 5.5	Prob =	0.877		
		Bonferroni Adjusted Prob =		1.000		
Difference in Means =	0.009	95.00% CI =	-0.127	to	0.144	
Pooled Variance t =	0.162	DF = 8	Prob =	0.876		
		Bonferroni Adjusted Prob =		1.000		
Difference in Means =	0.009	95.00% CI =	-0.116	to	0.133	

Two-sample t test on LMISCAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	1.703	0.446
EB49	5	1.395	0.253

Separate Variance t =	1.345	DF = 6.3	Prob =	0.225		
		Bonferroni Adjusted Prob =		1.000		
Difference in Means =	0.309	95.00% CI =	-0.246	to	0.863	
Pooled Variance t =	1.345	DF = 8	Prob =	0.216		
		Bonferroni Adjusted Prob =		1.000		
Difference in Means =	0.309	95.00% CI =	-0.220	to	0.838	

Two-sample t test on LTABUND grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.860	0.046
EB49	5	2.961	0.049

```
    Separate Variance t =        -3.377 DF =     7.9     Prob =         0.010
                                   Bonferroni Adjusted Prob =         0.059
    Difference in Means =        -0.102    95.00% CI =      -0.171 to     -0.032

      Pooled Variance t =        -3.377 DF =     8       Prob =         0.010
                                   Bonferroni Adjusted Prob =         0.058
    Difference in Means =        -0.102    95.00% CI =      -0.171 to     -0.032
```

Two-sample t test on TRICH grouped by STATION$

Group	N	Mean	SD
BK04A	5	88.200	9.066
EB49	5	88.400	8.905

```
    Separate Variance t =        -0.035 DF =     8.0     Prob =         0.973
                                   Bonferroni Adjusted Prob =         1.000
    Difference in Means =        -0.200    95.00% CI =     -13.306 to     12.906

      Pooled Variance t =        -0.035 DF =     8       Prob =         0.973
                                   Bonferroni Adjusted Prob =         1.000
    Difference in Means =        -0.200    95.00% CI =     -13.306 to     12.906
```

Two-sample t test on LCRSTAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.114	0.081
EB60	5	2.445	0.075

```
    Separate Variance t =        -6.681 DF =     8.0     Prob =         0.000
                                   Bonferroni Adjusted Prob =         0.001
    Difference in Means =        -0.330    95.00% CI =      -0.445 to     -0.216

      Pooled Variance t =        -6.681 DF =     8       Prob =         0.000
                                   Bonferroni Adjusted Prob =         0.001
    Difference in Means =        -0.330    95.00% CI =      -0.444 to     -0.216
```

Two-sample t test on LMOLLAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.431	0.069
EB60	5	2.943	0.065

```
    Separate Variance t =       -12.116 DF =     8.0     Prob =         0.000
                                   Bonferroni Adjusted Prob =         0.000
    Difference in Means =        -0.511    95.00% CI =      -0.608 to     -0.414

      Pooled Variance t =       -12.116 DF =     8       Prob =         0.000
                                   Bonferroni Adjusted Prob =         0.000
    Difference in Means =        -0.511    95.00% CI =      -0.608 to     -0.414
```

Two-sample t test on LPOLYAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.408	0.049
EB60	5	2.433	0.138

Separate Variance t = -0.381 DF = 5.0 Prob = 0.719
Bonferroni Adjusted Prob = 1.000
Difference in Means = -0.025 95.00% CI = -0.193 to 0.143

Pooled Variance t = -0.381 DF = 8 Prob = 0.713
Bonferroni Adjusted Prob = 1.000
Difference in Means = -0.025 95.00% CI = -0.175 to 0.126

Two-sample t test on LMISCAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	1.703	0.446
EB60	5	1.655	0.145

Separate Variance t = 0.229 DF = 4.8 Prob = 0.828
Bonferroni Adjusted Prob = 1.000
Difference in Means = 0.048 95.00% CI = -0.497 to 0.593

Pooled Variance t = 0.229 DF = 8 Prob = 0.824
Bonferroni Adjusted Prob = 1.000
Difference in Means = 0.048 95.00% CI = -0.436 to 0.532

Two-sample t test on LTABUND grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.860	0.046
EB60	5	3.171	0.055

Separate Variance t = -9.761 DF = 7.7 Prob = 0.000
Bonferroni Adjusted Prob = 0.000
Difference in Means = -0.311 95.00% CI = -0.385 to -0.237

Pooled Variance t = -9.761 DF = 8 Prob = 0.000
Bonferroni Adjusted Prob = 0.000
Difference in Means = -0.311 95.00% CI = -0.385 to -0.238

Two-sample t test on TRICH grouped by STATION$

Group	N	Mean	SD
BK04A	5	88.200	9.066
EB60	5	85.000	8.276

Separate Variance t = 0.583 DF = 7.9 Prob = 0.576
Bonferroni Adjusted Prob = 1.000
Difference in Means = 3.200 95.00% CI = -9.478 to 15.878

Pooled Variance t = 0.583 DF = 8 Prob = 0.576
Bonferroni Adjusted Prob = 1.000
Difference in Means = 3.200 95.00% CI = -9.460 to 15.860

Two-sample t test on LCRSTAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.114	0.081
EB67	5	2.319	0.183

Separate Variance t = -2.280 DF = 5.5 Prob = 0.067
Bonferroni Adjusted Prob = 0.400
Difference in Means = -0.204 95.00% CI = -0.429 to 0.020

Pooled Variance t = -2.280 DF = 8 Prob = 0.052
Bonferroni Adjusted Prob = 0.312
Difference in Means = -0.204 95.00% CI = -0.411 to 0.002

Two-sample t test on LMOLLAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.431	0.069
EB67	5	2.770	0.133

Separate Variance t = -5.057 DF = 6.0 Prob = 0.002
Bonferroni Adjusted Prob = 0.014
Difference in Means = -0.339 95.00% CI = -0.503 to -0.175

Pooled Variance t = -5.057 DF = 8 Prob = 0.001
Bonferroni Adjusted Prob = 0.006
Difference in Means = -0.339 95.00% CI = -0.493 to -0.184

Two-sample t test on LPOLYAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.408	0.049
EB67	5	2.339	0.106

Separate Variance t = 1.332 DF = 5.6 Prob = 0.234
Bonferroni Adjusted Prob = 1.000
Difference in Means = 0.070 95.00% CI = -0.060 to 0.199

Pooled Variance t = 1.332 DF = 8 Prob = 0.219
Bonferroni Adjusted Prob = 1.000
Difference in Means = 0.070 95.00% CI = -0.051 to 0.190

Two-sample t test on LMISCAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	1.703	0.446
EB67	5	1.581	0.146

Separate Variance t = 0.580 DF = 4.8 Prob = 0.588
Bonferroni Adjusted Prob = 1.000
Difference in Means = 0.122 95.00% CI = -0.423 to 0.667

Pooled Variance t = 0.580 DF = 8 Prob = 0.578
Bonferroni Adjusted Prob = 1.000
Difference in Means = 0.122 95.00% CI = -0.363 to 0.606

Two-sample t test on LTABUND grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.860	0.046
EB67	5	3.027	0.120

Separate Variance t = -2.918 DF = 5.1 Prob = 0.032
Bonferroni Adjusted Prob = 0.192
Difference in Means = -0.167 95.00% CI = -0.313 to -0.021

Pooled Variance t = -2.918 DF = 8 Prob = 0.019
Bonferroni Adjusted Prob = 0.116
Difference in Means = -0.167 95.00% CI = -0.299 to -0.035

Two-sample t test on TRICH grouped by STATION$

Group	N	Mean	SD
BK04A	5	88.200	9.066
EB67	5	81.800	11.904

Separate Variance t = 0.956 DF = 7.5 Prob = 0.369
Bonferroni Adjusted Prob = 1.000
Difference in Means = 6.400 95.00% CI = -9.223 to 22.023

Pooled Variance t = 0.956 DF = 8 Prob = 0.367
Bonferroni Adjusted Prob = 1.000
Difference in Means = 6.400 95.00% CI = -9.031 to 21.831

Two-sample t test on LCRSTAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.114	0.081
EB77	5	2.528	0.165

Separate Variance t = -5.041 DF = 5.8 Prob = 0.003
Bonferroni Adjusted Prob = 0.015
Difference in Means = -0.414 95.00% CI = -0.616 to -0.211

Pooled Variance t = -5.041 DF = 8 Prob = 0.001
Bonferroni Adjusted Prob = 0.006
Difference in Means = -0.414 95.00% CI = -0.603 to -0.224

Two-sample t test on LMOLLAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.431	0.069
EB77	5	2.742	0.107

Separate Variance t = -5.464 DF = 6.8 Prob = 0.001
Bonferroni Adjusted Prob = 0.006
Difference in Means = -0.311 95.00% CI = -0.446 to -0.175

Pooled Variance t = -5.464 DF = 8 Prob = 0.001
Bonferroni Adjusted Prob = 0.004
Difference in Means = -0.311 95.00% CI = -0.442 to -0.179

Two-sample t test on LPOLYAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.408	0.049
EB77	5	2.521	0.055

```
Separate Variance t =      -3.426 DF =    7.9     Prob =         0.009
                             Bonferroni Adjusted Prob =         0.055
  Difference in Means =    -0.113    95.00% CI =     -0.189 to     -0.037

    Pooled Variance t =    -3.426 DF =    8       Prob =         0.009
                             Bonferroni Adjusted Prob =         0.054
  Difference in Means =    -0.113    95.00% CI =     -0.189 to     -0.037
```

Two-sample t test on LMISCAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	1.703	0.446
EB77	5	1.112	0.206

```
Separate Variance t =       2.689 DF =    5.6     Prob =         0.038
                             Bonferroni Adjusted Prob =         0.231
  Difference in Means =     0.591    95.00% CI =      0.045 to      1.138

    Pooled Variance t =     2.689 DF =    8       Prob =         0.028
                             Bonferroni Adjusted Prob =         0.165
  Difference in Means =     0.591    95.00% CI =      0.084 to      1.098
```

Two-sample t test on LTABUND grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.860	0.046
EB77	5	3.094	0.097

```
Separate Variance t =      -4.910 DF =    5.7     Prob =         0.003
                             Bonferroni Adjusted Prob =         0.019
  Difference in Means =    -0.234    95.00% CI =     -0.353 to     -0.116

    Pooled Variance t =    -4.910 DF =    8       Prob =         0.001
                             Bonferroni Adjusted Prob =         0.007
  Difference in Means =    -0.234    95.00% CI =     -0.345 to     -0.124
```

Two-sample t test on TRICH grouped by STATION$

Group	N	Mean	SD
BK04A	5	88.200	9.066
EB77	5	88.600	8.792

```
Separate Variance t =      -0.071 DF =    8.0     Prob =         0.945
                             Bonferroni Adjusted Prob =         1.000
  Difference in Means =    -0.400    95.00% CI =    -13.426 to     12.626

    Pooled Variance t =    -0.071 DF =    8       Prob =         0.945
                             Bonferroni Adjusted Prob =         1.000
  Difference in Means =    -0.400    95.00% CI =    -13.424 to     12.624
```

Two-sample t test on LCRSTAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.114	0.081
EB80	5	2.279	0.119

```
Separate Variance t =     -2.552 DF =    7.0    Prob =         0.038
                           Bonferroni Adjusted Prob =         0.227
Difference in Means =     -0.164   95.00% CI =    -0.317 to    -0.012

  Pooled Variance t =     -2.552 DF =    8      Prob =         0.034
                           Bonferroni Adjusted Prob =         0.204
Difference in Means =     -0.164   95.00% CI =    -0.313 to    -0.016
```

Two-sample t test on LMOLLAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.431	0.069
EB80	5	2.836	0.258

```
Separate Variance t =     -3.397 DF =    4.6    Prob =         0.022
                           Bonferroni Adjusted Prob =         0.133
Difference in Means =     -0.405   95.00% CI =    -0.721 to    -0.090

  Pooled Variance t =     -3.397 DF =    8      Prob =         0.009
                           Bonferroni Adjusted Prob =         0.056
Difference in Means =     -0.405   95.00% CI =    -0.680 to    -0.130
```

Two-sample t test on LPOLYAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.408	0.049
EB80	5	2.328	0.103

```
Separate Variance t =      1.580 DF =    5.7    Prob =         0.168
                           Bonferroni Adjusted Prob =         1.000
Difference in Means =      0.080   95.00% CI =    -0.046 to     0.207

  Pooled Variance t =      1.580 DF =    8      Prob =         0.153
                           Bonferroni Adjusted Prob =         0.917
Difference in Means =      0.080   95.00% CI =    -0.037 to     0.198
```

Two-sample t test on LMISCAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	1.703	0.446
EB80	5	1.223	0.258

```
Separate Variance t =      2.083 DF =    6.4    Prob =         0.080
                           Bonferroni Adjusted Prob =         0.477
Difference in Means =      0.480   95.00% CI =    -0.075 to     1.036

  Pooled Variance t =      2.083 DF =    8      Prob =         0.071
                           Bonferroni Adjusted Prob =         0.425
Difference in Means =      0.480   95.00% CI =    -0.051 to     1.012
```

```
Two-sample t test on LTABUND grouped by STATION$

 Group                 N          Mean          SD
   BK04A               5          2.860         0.046
   EB80                5          3.052         0.179

    Separate Variance t =       -2.327 DF =     4.5     Prob =          0.073
                                  Bonferroni Adjusted Prob =          0.438
    Difference in Means =       -0.192   95.00% CI =      -0.412 to      0.027

       Pooled Variance t =      -2.327 DF =     8       Prob =          0.048
                                  Bonferroni Adjusted Prob =          0.290
    Difference in Means =       -0.192   95.00% CI =      -0.383 to     -0.002

Two-sample t test on TRICH grouped by STATION$

 Group                 N          Mean          SD
   BK04A               5         88.200         9.066
   EB80                5         76.600         4.980

    Separate Variance t =        2.508 DF =     6.2     Prob =          0.045
                                  Bonferroni Adjusted Prob =          0.268
    Difference in Means =       11.600   95.00% CI =       0.374 to     22.826

       Pooled Variance t =       2.508 DF =     8       Prob =          0.037
                                  Bonferroni Adjusted Prob =          0.219
    Difference in Means =       11.600   95.00% CI =       0.932 to     22.268

Two-sample t test on LCRSTAB grouped by STATION$

 Group                 N          Mean          SD
   BK04A               5          2.114         0.081
   EB85                5          2.482         0.067

    Separate Variance t =       -7.852 DF =     7.7     Prob =          0.000
                                  Bonferroni Adjusted Prob =          0.000
    Difference in Means =       -0.368   95.00% CI =      -0.477 to     -0.259

       Pooled Variance t =      -7.852 DF =     8       Prob =          0.000
                                  Bonferroni Adjusted Prob =          0.000
    Difference in Means =       -0.368   95.00% CI =      -0.476 to     -0.260

Two-sample t test on LMOLLAB grouped by STATION$

 Group                 N          Mean          SD
   BK04A               5          2.431         0.069
   EB85                5          2.943         0.119

    Separate Variance t =       -8.301 DF =     6.4     Prob =          0.000
                                  Bonferroni Adjusted Prob =          0.001
    Difference in Means =       -0.512   95.00% CI =      -0.660 to     -0.363

       Pooled Variance t =      -8.301 DF =     8       Prob =          0.000
                                  Bonferroni Adjusted Prob =          0.000
    Difference in Means =       -0.512   95.00% CI =      -0.654 to     -0.370
```

Two-sample t test on LPOLYAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.408	0.049
EB85	5	2.375	0.124

```
Separate Variance t =      0.554 DF =    5.2    Prob =       0.602
                            Bonferroni Adjusted Prob =       1.000
Difference in Means =      0.033   95.00% CI =    -0.118 to     0.184

  Pooled Variance t =      0.554 DF =    8      Prob =       0.594
                            Bonferroni Adjusted Prob =       1.000
Difference in Means =      0.033   95.00% CI =    -0.104 to     0.170
```

Two-sample t test on LMISCAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	1.703	0.446
EB85	5	1.243	0.154

```
Separate Variance t =      2.177 DF =    4.9    Prob =       0.082
                            Bonferroni Adjusted Prob =       0.492
Difference in Means =      0.460   95.00% CI =    -0.085 to     1.005

  Pooled Variance t =      2.177 DF =    8      Prob =       0.061
                            Bonferroni Adjusted Prob =       0.367
Difference in Means =      0.460   95.00% CI =    -0.027 to     0.947
```

Two-sample t test on LTABUND grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.860	0.046
EB85	5	3.158	0.104

```
Separate Variance t =     -5.878 DF =    5.5    Prob =       0.001
                            Bonferroni Adjusted Prob =       0.009
Difference in Means =     -0.298   95.00% CI =    -0.425 to    -0.171

  Pooled Variance t =     -5.878 DF =    8      Prob =       0.000
                            Bonferroni Adjusted Prob =       0.002
Difference in Means =     -0.298   95.00% CI =    -0.415 to    -0.181
```

Two-sample t test on TRICH grouped by STATION$

Group	N	Mean	SD
BK04A	5	88.200	9.066
EB85	5	85.800	15.123

```
Separate Variance t =      0.304 DF =    6.5    Prob =       0.770
                            Bonferroni Adjusted Prob =       1.000
Difference in Means =      2.400   95.00% CI =   -16.511 to    21.311

  Pooled Variance t =      0.304 DF =    8      Prob =       0.769
                            Bonferroni Adjusted Prob =       1.000
Difference in Means =      2.400   95.00% CI =   -15.784 to    20.584
```

Two-sample t test on LCRSTAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.114	0.081
EB87	5	2.389	0.114

```
Separate Variance t =    -4.378 DF =    7.2    Prob =       0.003
                          Bonferroni Adjusted Prob =        0.018
Difference in Means =    -0.274   95.00% CI =    -0.422 to    -0.127

  Pooled Variance t =    -4.378 DF =    8      Prob =       0.002
                          Bonferroni Adjusted Prob =        0.014
Difference in Means =    -0.274   95.00% CI =    -0.419 to    -0.130
```

Two-sample t test on LMOLLAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.431	0.069
EB87	5	2.448	0.054

```
Separate Variance t =    -0.412 DF =    7.6    Prob =       0.692
                          Bonferroni Adjusted Prob =        1.000
Difference in Means =    -0.016   95.00% CI =    -0.107 to     0.075

  Pooled Variance t =    -0.412 DF =    8      Prob =       0.691
                          Bonferroni Adjusted Prob =        1.000
Difference in Means =    -0.016   95.00% CI =    -0.106 to     0.074
```

Two-sample t test on LPOLYAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.408	0.049
EB87	5	2.813	0.058

```
Separate Variance t =   -11.979 DF =    7.8    Prob =       0.000
                          Bonferroni Adjusted Prob =        0.000
Difference in Means =    -0.405   95.00% CI =    -0.483 to    -0.326

  Pooled Variance t =   -11.979 DF =    8      Prob =       0.000
                          Bonferroni Adjusted Prob =        0.000
Difference in Means =    -0.405   95.00% CI =    -0.483 to    -0.327
```

Two-sample t test on LMISCAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	1.703	0.446
EB87	5	1.198	0.224

```
Separate Variance t =     2.261 DF =    5.9    Prob =       0.065
                          Bonferroni Adjusted Prob =        0.391
Difference in Means =     0.505   95.00% CI =    -0.044 to     1.054

  Pooled Variance t =     2.261 DF =    8      Prob =       0.054
                          Bonferroni Adjusted Prob =        0.322
Difference in Means =     0.505   95.00% CI =    -0.010 to     1.020
```

```
Two-sample t test on LTABUND grouped by STATION$

 Group              N        Mean          SD
   BK04A            5        2.860        0.046
   EB87             5        3.079        0.035

    Separate Variance t =       -8.500 DF =     7.5     Prob =         0.000
                                  Bonferroni Adjusted Prob =         0.000
    Difference in Means =       -0.219   95.00% CI =      -0.280 to     -0.159

      Pooled Variance t =       -8.500 DF =     8       Prob =         0.000
                                  Bonferroni Adjusted Prob =         0.000
    Difference in Means =       -0.219   95.00% CI =      -0.279 to     -0.160

Two-sample t test on TRICH grouped by STATION$

 Group              N        Mean          SD
   BK04A            5       88.200        9.066
   EB87             5      111.600        6.189

    Separate Variance t =       -4.767 DF =     7.1     Prob =         0.002
                                  Bonferroni Adjusted Prob =         0.012
    Difference in Means =      -23.400   95.00% CI =     -34.988 to    -11.812

      Pooled Variance t =       -4.767 DF =     8       Prob =         0.001
                                  Bonferroni Adjusted Prob =         0.008
    Difference in Means =      -23.400   95.00% CI =     -34.721 to    -12.079

Two-sample t test on LCRSTAB grouped by STATION$

 Group              N        Mean          SD
   BK04A            5        2.114        0.081
   EB104            5        2.461        0.075

    Separate Variance t =       -7.017 DF =     8.0     Prob =         0.000
                                  Bonferroni Adjusted Prob =         0.001
    Difference in Means =       -0.347   95.00% CI =      -0.461 to     -0.233

      Pooled Variance t =       -7.017 DF =     8       Prob =         0.000
                                  Bonferroni Adjusted Prob =         0.001
    Difference in Means =       -0.347   95.00% CI =      -0.461 to     -0.233

Two-sample t test on LMOLLAB grouped by STATION$

 Group              N        Mean          SD
   BK04A            5        2.431        0.069
   EB104            5        2.743        0.189

    Separate Variance t =       -3.461 DF =     5.0     Prob =         0.018
                                  Bonferroni Adjusted Prob =         0.107
    Difference in Means =       -0.312   95.00% CI =      -0.543 to     -0.081

      Pooled Variance t =       -3.461 DF =     8       Prob =         0.009
                                  Bonferroni Adjusted Prob =         0.051
    Difference in Means =       -0.312   95.00% CI =      -0.520 to     -0.104
```

Two-sample t test on LPOLYAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.408	0.049
EB104	5	2.634	0.091

```
Separate Variance t =     -4.877 DF =    6.1    Prob =        0.003
                           Bonferroni Adjusted Prob =         0.016
Difference in Means =     -0.226   95.00% CI =    -0.338 to    -0.113

   Pooled Variance t =    -4.877 DF =    8      Prob =        0.001
                           Bonferroni Adjusted Prob =         0.007
Difference in Means =     -0.226   95.00% CI =    -0.332 to    -0.119
```

Two-sample t test on LMISCAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	1.703	0.446
EB104	5	1.457	0.154

```
Separate Variance t =      1.168 DF =    4.9    Prob =        0.296
                           Bonferroni Adjusted Prob =         1.000
Difference in Means =      0.247   95.00% CI =    -0.298 to     0.791

   Pooled Variance t =     1.168 DF =    8      Prob =        0.277
                           Bonferroni Adjusted Prob =         1.000
Difference in Means =      0.247   95.00% CI =    -0.240 to     0.734
```

Two-sample t test on LTABUND grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.860	0.046
EB104	5	3.126	0.088

```
Separate Variance t =     -5.980 DF =    6.0    Prob =        0.001
                           Bonferroni Adjusted Prob =         0.006
Difference in Means =     -0.266   95.00% CI =    -0.375 to    -0.157

   Pooled Variance t =    -5.980 DF =    8      Prob =        0.000
                           Bonferroni Adjusted Prob =         0.002
Difference in Means =     -0.266   95.00% CI =    -0.369 to    -0.163
```

Two-sample t test on TRICH grouped by STATION$

Group	N	Mean	SD
BK04A	5	88.200	9.066
EB104	5	111.000	8.602

```
Separate Variance t =     -4.079 DF =    8.0    Prob =        0.004
                           Bonferroni Adjusted Prob =         0.021
Difference in Means =    -22.800   95.00% CI =   -35.695 to    -9.905

   Pooled Variance t =    -4.079 DF =    8      Prob =        0.004
                           Bonferroni Adjusted Prob =         0.021
Difference in Means =    -22.800   95.00% CI =   -35.689 to    -9.911
```

Two-sample t test on LCRSTAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.114	0.081
EB106	5	2.056	0.056

```
 Separate Variance t =      1.315 DF =    7.1    Prob =        0.229
                             Bonferroni Adjusted Prob =        1.000
 Difference in Means =      0.058   95.00% CI =     -0.046 to      0.162

   Pooled Variance t =      1.315 DF =    8      Prob =        0.225
                             Bonferroni Adjusted Prob =        1.000
 Difference in Means =      0.058   95.00% CI =     -0.044 to      0.160
```

Two-sample t test on LMOLLAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.431	0.069
EB106	5	2.472	0.115

```
 Separate Variance t =     -0.674 DF =    6.5    Prob =        0.524
                             Bonferroni Adjusted Prob =        1.000
 Difference in Means =     -0.040   95.00% CI =     -0.184 to      0.104

   Pooled Variance t =     -0.674 DF =    8      Prob =        0.520
                             Bonferroni Adjusted Prob =        1.000
 Difference in Means =     -0.040   95.00% CI =     -0.179 to      0.098
```

Two-sample t test on LPOLYAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.408	0.049
EB106	5	2.439	0.089

```
 Separate Variance t =     -0.672 DF =    6.2    Prob =        0.526
                             Bonferroni Adjusted Prob =        1.000
 Difference in Means =     -0.031   95.00% CI =     -0.141 to      0.080

   Pooled Variance t =     -0.672 DF =    8      Prob =        0.520
                             Bonferroni Adjusted Prob =        1.000
 Difference in Means =     -0.031   95.00% CI =     -0.136 to      0.074
```

Two-sample t test on LMISCAB grouped by STATION$

Group	N	Mean	SD
BK04A	5	1.703	0.446
EB106	5	1.433	0.388

```
 Separate Variance t =      1.019 DF =    7.8    Prob =        0.338
                             Bonferroni Adjusted Prob =        1.000
 Difference in Means =      0.270   95.00% CI =     -0.342 to      0.882

   Pooled Variance t =      1.019 DF =    8      Prob =        0.338
                             Bonferroni Adjusted Prob =        1.000
 Difference in Means =      0.270   95.00% CI =     -0.340 to      0.880
```

Two-sample t test on LTABUND grouped by STATION$

Group	N	Mean	SD
BK04A	5	2.860	0.046
EB106	5	2.862	0.042

```
Separate Variance t =     -0.087 DF =    7.9    Prob =        0.933
                           Bonferroni Adjusted Prob =       1.000
Difference in Means =     -0.002   95.00% CI =    -0.066 to     0.061

Pooled Variance t =       -0.087 DF =    8      Prob =        0.933
                           Bonferroni Adjusted Prob =       1.000
Difference in Means =     -0.002   95.00% CI =    -0.066 to     0.061
```

Two-sample t test on TRICH grouped by STATION$

Group	N	Mean	SD
BK04A	5	88.200	9.066
EB106	5	84.200	4.919

```
Separate Variance t =      0.867 DF =    6.2    Prob =        0.418
                           Bonferroni Adjusted Prob =       1.000
Difference in Means =      4.000   95.00% CI =    -7.214 to    15.214

Pooled Variance t =        0.867 DF =    8      Prob =        0.411
                           Bonferroni Adjusted Prob =       1.000
Difference in Means =      4.000   95.00% CI =    -6.638 to    14.638
```

```
Two-sample t test on TCRSTRC grouped by STATION$

 Group                    N          Mean            SD
   BK04A                  5         14.000         2.550
   EB49                   5          9.800         2.588

     Separate Variance t =          2.585 DF =     8.0    Prob =         0.032
     Difference in Means =          4.200   95.00% CI =      0.453 to       7.947

       Pooled Variance t =          2.585 DF =     8      Prob =         0.032
     Difference in Means =          4.200   95.00% CI =      0.453 to       7.947

Two-sample t test on TMOLLRC grouped by STATION$

 Group                    N          Mean            SD
   BK04A                  5         22.000         3.464
   EB49                   5         20.000         2.345

     Separate Variance t =          1.069 DF =     7.0    Prob =         0.320
     Difference in Means =          2.000   95.00% CI =     -2.420 to       6.420

       Pooled Variance t =          1.069 DF =     8      Prob =         0.316
     Difference in Means =          2.000   95.00% CI =     -2.314 to       6.314

Two-sample t test on TPOLYRC grouped by STATION$

 Group                    N          Mean            SD
   BK04A                  5         46.400         5.771
   EB49                   5         51.000         6.819

     Separate Variance t =         -1.151 DF =     7.8    Prob =         0.284
     Difference in Means =         -4.600   95.00% CI =    -13.857 to       4.657

       Pooled Variance t =         -1.151 DF =     8      Prob =         0.283
     Difference in Means =         -4.600   95.00% CI =    -13.812 to       4.612

Two-sample t test on TMISCRC grouped by STATION$

 Group                    N          Mean            SD
   BK04A                  5          5.800         1.304
   EB49                   5          7.600         1.817

     Separate Variance t =         -1.800 DF =     7.3    Prob =         0.113
     Difference in Means =         -1.800   95.00% CI =     -4.148 to       0.548

       Pooled Variance t =         -1.800 DF =     8      Prob =         0.110
     Difference in Means =         -1.800   95.00% CI =     -4.106 to       0.506

Two-sample t test on TCRSTRC grouped by STATION$

 Group                    N          Mean            SD
   BK04A                  5         14.000         2.550
   EB60                   5         10.400         2.302

     Separate Variance t =          2.343 DF =     7.9    Prob =         0.047
     Difference in Means =          3.600   95.00% CI =      0.051 to       7.149

       Pooled Variance t =          2.343 DF =     8      Prob =         0.047
     Difference in Means =          3.600   95.00% CI =      0.057 to       7.143

Two-sample t test on TMOLLRC grouped by STATION$

 Group                    N          Mean            SD
   BK04A                  5         22.000         3.464
   EB60                   5         21.200         1.643

     Separate Variance t =          0.467 DF =     5.7    Prob =         0.658
     Difference in Means =          0.800   95.00% CI =     -3.447 to       5.047

       Pooled Variance t =          0.467 DF =     8      Prob =         0.653
     Difference in Means =          0.800   95.00% CI =     -3.154 to       4.754

Two-sample t test on TPOLYRC grouped by STATION$

 Group                    N          Mean            SD
   BK04A                  5         46.400         5.771
   EB60                   5         47.800         8.228

     Separate Variance t =         -0.311 DF =     7.2    Prob =         0.764
```

```
   Difference in Means =      -1.400   95.00% CI =    -11.977 to      9.177

     Pooled Variance t =      -0.311 DF =     8      Prob =          0.763
   Difference in Means =      -1.400   95.00% CI =    -11.764 to      8.964

Two-sample t test on TMISCRC grouped by STATION$

 Group                 N         Mean          SD
   BK04A               5        5.800        1.304
   EB60                5        5.600        0.894

   Separate Variance t =        0.283 DF =     7.1    Prob =          0.785
   Difference in Means =        0.200   95.00% CI =    -1.468 to      1.868

     Pooled Variance t =        0.283 DF =     8      Prob =          0.784
   Difference in Means =        0.200   95.00% CI =    -1.431 to      1.831

Two-sample t test on TCRSTRC grouped by STATION$

 Group                 N         Mean          SD
   BK04A               5       14.000        2.550
   EB67                5       13.600        5.857

   Separate Variance t =        0.140 DF =     5.5    Prob =          0.894
   Difference in Means =        0.400   95.00% CI =    -6.760 to      7.560

     Pooled Variance t =        0.140 DF =     8      Prob =          0.892
   Difference in Means =        0.400   95.00% CI =    -6.187 to      6.987

Two-sample t test on TMOLLRC grouped by STATION$

 Group                 N         Mean          SD
   BK04A               5       22.000        3.464
   EB67                5       18.000        2.345

   Separate Variance t =        2.138 DF =     7.0    Prob =          0.070
   Difference in Means =        4.000   95.00% CI =    -0.420 to      8.420

     Pooled Variance t =        2.138 DF =     8      Prob =          0.065
   Difference in Means =        4.000   95.00% CI =    -0.314 to      8.314

Two-sample t test on TPOLYRC grouped by STATION$

 Group                 N         Mean          SD
   BK04A               5       46.400        5.771
   EB67                5       44.400        7.635

   Separate Variance t =        0.467 DF =     7.4    Prob =          0.654
   Difference in Means =        2.000   95.00% CI =    -8.000 to     12.000

     Pooled Variance t =        0.467 DF =     8      Prob =          0.653
   Difference in Means =        2.000   95.00% CI =    -7.870 to     11.870

Two-sample t test on TMISCRC grouped by STATION$

 Group                 N         Mean          SD
   BK04A               5        5.800        1.304
   EB67                5        5.800        0.447

   Separate Variance t =        0.0 DF =     4.9    Prob =          1.000
   Difference in Means =        0.0   95.00% CI =    -1.592 to      1.592

     Pooled Variance t =        0.0 DF =     8      Prob =          1.000
   Difference in Means =        0.0   95.00% CI =    -1.422 to      1.422

Two-sample t test on TCRSTRC grouped by STATION$

 Group                 N         Mean          SD
   BK04A               5       14.000        2.550
   EB77                5       12.200        2.864

   Separate Variance t =        1.050 DF =     7.9    Prob =          0.325
   Difference in Means =        1.800   95.00% CI =    -2.163 to      5.763

     Pooled Variance t =        1.050 DF =     8      Prob =          0.324
   Difference in Means =        1.800   95.00% CI =    -2.154 to      5.754

Two-sample t test on TMOLLRC grouped by STATION$

 Group                 N         Mean          SD
```

BK04A	5	22.000	3.464
EB77	5	19.800	4.087

```
Separate Variance t =      0.918 DF =    7.8    Prob =      0.386
Difference in Means =      2.200   95.00% CI =    -3.351 to     7.751

  Pooled Variance t =      0.918 DF =    8      Prob =      0.385
Difference in Means =      2.200   95.00% CI =    -3.325 to     7.725
```

Two-sample t test on TPOLYRC grouped by STATION$

Group	N	Mean	SD
BK04A	5	46.400	5.771
EB77	5	53.000	4.637

```
Separate Variance t =     -1.994 DF =    7.6    Prob =      0.083
Difference in Means =     -6.600   95.00% CI =   -14.296 to     1.096

  Pooled Variance t =     -1.994 DF =    8      Prob =      0.081
Difference in Means =     -6.600   95.00% CI =   -14.234 to     1.034
```

Two-sample t test on TMISCRC grouped by STATION$

Group	N	Mean	SD
BK04A	5	5.800	1.304
EB77	5	3.600	1.517

```
Separate Variance t =      2.460 DF =    7.8    Prob =      0.040
Difference in Means =      2.200   95.00% CI =     0.129 to     4.271

  Pooled Variance t =      2.460 DF =    8      Prob =      0.039
Difference in Means =      2.200   95.00% CI =     0.137 to     4.263
```

Two-sample t test on TCRSTRC grouped by STATION$

Group	N	Mean	SD
BK04A	5	14.000	2.550
EB80	5	12.600	2.510

```
Separate Variance t =      0.875 DF =    8.0    Prob =      0.407
Difference in Means =      1.400   95.00% CI =    -2.290 to     5.090

  Pooled Variance t =      0.875 DF =    8      Prob =      0.407
Difference in Means =      1.400   95.00% CI =    -2.290 to     5.090
```

Two-sample t test on TMOLLRC grouped by STATION$

Group	N	Mean	SD
BK04A	5	22.000	3.464
EB80	5	16.600	2.793

```
Separate Variance t =      2.714 DF =    7.7    Prob =      0.028
Difference in Means =      5.400   95.00% CI =     0.775 to    10.025

  Pooled Variance t =      2.714 DF =    8      Prob =      0.027
Difference in Means =      5.400   95.00% CI =     0.811 to     9.989
```

Two-sample t test on TPOLYRC grouped by STATION$

Group	N	Mean	SD
BK04A	5	46.400	5.771
EB80	5	42.400	3.209

```
Separate Variance t =      1.355 DF =    6.3    Prob =      0.222
Difference in Means =      4.000   95.00% CI =    -3.154 to    11.154

  Pooled Variance t =      1.355 DF =    8      Prob =      0.213
Difference in Means =      4.000   95.00% CI =    -2.810 to    10.810
```

Two-sample t test on TMISCRC grouped by STATION$

Group	N	Mean	SD
BK04A	5	5.800	1.304
EB80	5	5.000	2.345

```
Separate Variance t =      0.667 DF =    6.3    Prob =      0.529
Difference in Means =      0.800   95.00% CI =    -2.107 to     3.707

  Pooled Variance t =      0.667 DF =    8      Prob =      0.524
Difference in Means =      0.800   95.00% CI =    -1.967 to     3.567
```

Two-sample t test on TCRSTRC grouped by STATION$

Group	N	Mean	SD
BK04A	5	14.000	2.550
EB85	5	16.600	5.177

```
Separate Variance t =     -1.007 DF =    5.8    Prob =       0.354
Difference in Means =     -2.600  95.00% CI =   -8.959 to     3.759

  Pooled Variance t =     -1.007 DF =    8      Prob =       0.343
Difference in Means =     -2.600  95.00% CI =   -8.551 to     3.351
```

Two-sample t test on TMOLLRC grouped by STATION$

Group	N	Mean	SD
BK04A	5	22.000	3.464
EB85	5	19.000	1.000

```
Separate Variance t =      1.861 DF =    4.7    Prob =       0.126
Difference in Means =      3.000  95.00% CI =   -1.237 to     7.237

  Pooled Variance t =      1.861 DF =    8      Prob =       0.100
Difference in Means =      3.000  95.00% CI =   -0.718 to     6.718
```

Two-sample t test on TPOLYRC grouped by STATION$

Group	N	Mean	SD
BK04A	5	46.400	5.771
EB85	5	45.600	10.359

```
Separate Variance t =      0.151 DF =    6.3    Prob =       0.885
Difference in Means =      0.800  95.00% CI =  -12.044 to    13.644

  Pooled Variance t =      0.151 DF =    8      Prob =       0.884
Difference in Means =      0.800  95.00% CI =  -11.428 to    13.028
```

Two-sample t test on TMISCRC grouped by STATION$

Group	N	Mean	SD
BK04A	5	5.800	1.304
EB85	5	4.600	0.548

```
Separate Variance t =      1.897 DF =    5.4    Prob =       0.112
Difference in Means =      1.200  95.00% CI =   -0.393 to     2.793

  Pooled Variance t =      1.897 DF =    8      Prob =       0.094
Difference in Means =      1.200  95.00% CI =   -0.258 to     2.658
```

Two-sample t test on TCRSTRC grouped by STATION$

Group	N	Mean	SD
BK04A	5	14.000	2.550
EB87	5	20.200	4.970

```
Separate Variance t =     -2.482 DF =    6.0    Prob =       0.048
Difference in Means =     -6.200  95.00% CI =  -12.320 to    -0.080

  Pooled Variance t =     -2.482 DF =    8      Prob =       0.038
Difference in Means =     -6.200  95.00% CI =  -11.960 to    -0.440
```

Two-sample t test on TMOLLRC grouped by STATION$

Group	N	Mean	SD
BK04A	5	22.000	3.464
EB87	5	18.600	1.949

```
Separate Variance t =      1.913 DF =    6.3    Prob =       0.102
Difference in Means =      3.400  95.00% CI =   -0.900 to     7.700

  Pooled Variance t =      1.913 DF =    8      Prob =       0.092
Difference in Means =      3.400  95.00% CI =   -0.699 to     7.499
```

Two-sample t test on TPOLYRC grouped by STATION$

Group	N	Mean	SD
BK04A	5	46.400	5.771
EB87	5	66.600	4.722

```
Separate Variance t =     -6.058 DF =    7.7    Prob =       0.000
```

```
    Difference in Means =      -20.200   95.00% CI =    -27.942 to    -12.458

      Pooled Variance t =      -6.058 DF =     8      Prob =        0.000
    Difference in Means =      -20.200   95.00% CI =    -27.890 to    -12.510

Two-sample t test on TMISCRC grouped by STATION$

  Group                  N         Mean           SD
    BK04A                5         5.800        1.304
    EB87                 5         6.200        0.837

    Separate Variance t =      -0.577 DF =    6.8     Prob =        0.582
    Difference in Means =      -0.400    95.00% CI =    -2.047 to      1.247

      Pooled Variance t =      -0.577 DF =     8      Prob =        0.580
    Difference in Means =      -0.400    95.00% CI =    -1.998 to      1.198

Two-sample t test on TCRSTRC grouped by STATION$

  Group                  N         Mean           SD
    BK04A                5        14.000        2.550
    EB104                5        22.000        6.285

    Separate Variance t =      -2.638 DF =    5.3     Prob =        0.044
    Difference in Means =      -8.000    95.00% CI =   -15.674 to     -0.326

      Pooled Variance t =      -2.638 DF =     8      Prob =        0.030
    Difference in Means =      -8.000    95.00% CI =   -14.994 to     -1.006

Two-sample t test on TMOLLRC grouped by STATION$

  Group                  N         Mean           SD
    BK04A                5        22.000        3.464
    EB104                5        20.800        2.049

    Separate Variance t =       0.667 DF =    6.5     Prob =        0.528
    Difference in Means =       1.200    95.00% CI =    -3.124 to      5.524

      Pooled Variance t =       0.667 DF =     8      Prob =        0.524
    Difference in Means =       1.200    95.00% CI =    -2.951 to      5.351

Two-sample t test on TPOLYRC grouped by STATION$

  Group                  N         Mean           SD
    BK04A                5        46.400        5.771
    EB104                5        63.400        4.669

    Separate Variance t =      -5.121 DF =    7.7     Prob =        0.001
    Difference in Means =     -17.000    95.00% CI =   -24.714 to     -9.286

      Pooled Variance t =      -5.121 DF =     8      Prob =        0.001
    Difference in Means =     -17.000    95.00% CI =   -24.655 to     -9.345

Two-sample t test on TMISCRC grouped by STATION$

  Group                  N         Mean           SD
    BK04A                5         5.800        1.304
    EB104                5         4.800        1.095

    Separate Variance t =       1.313 DF =    7.8     Prob =        0.227
    Difference in Means =       1.000    95.00% CI =    -0.765 to      2.765

      Pooled Variance t =       1.313 DF =     8      Prob =        0.226
    Difference in Means =       1.000    95.00% CI =    -0.756 to      2.756

Two-sample t test on TCRSTRC grouped by STATION$

  Group                  N         Mean           SD
    BK04A                5        14.000        2.550
    EB106                5        14.200        1.483

    Separate Variance t =      -0.152 DF =    6.4     Prob =        0.884
    Difference in Means =      -0.200    95.00% CI =    -3.376 to      2.976

      Pooled Variance t =      -0.152 DF =     8      Prob =        0.883
    Difference in Means =      -0.200    95.00% CI =    -3.242 to      2.842

Two-sample t test on TMOLLRC grouped by STATION$

  Group                  N         Mean           SD
```

```
    BK04A              5       22.000         3.464
    EB106              5       18.000         0.707

     Separate Variance t =        2.530 DF =    4.3     Prob =         0.060
     Difference in Means =        4.000   95.00% CI =    -0.260 to       8.260

       Pooled Variance t =        2.530 DF =    8       Prob =         0.035
     Difference in Means =        4.000   95.00% CI =     0.354 to       7.646

Two-sample t test on TPOLYRC grouped by STATION$

  Group                N          Mean            SD
    BK04A              5       46.400         5.771
    EB106              5       44.800         4.764

     Separate Variance t =        0.478 DF =    7.7     Prob =         0.646
     Difference in Means =        1.600   95.00% CI =    -6.166 to       9.366

       Pooled Variance t =        0.478 DF =    8       Prob =         0.645
     Difference in Means =        1.600   95.00% CI =    -6.117 to       9.317

Two-sample t test on TMISCRC grouped by STATION$

  Group                N          Mean            SD
    BK04A              5        5.800         1.304
    EB106              5        7.200         3.347

     Separate Variance t =       -0.872 DF =    5.2     Prob =         0.422
     Difference in Means =       -1.400   95.00% CI =    -5.485 to       2.685

       Pooled Variance t =       -0.872 DF =    8       Prob =         0.409
     Difference in Means =       -1.400   95.00% CI =    -5.104 to       2.304

>
```

ANOVA with Dunnett's

ANOVA w/Dunnett's Results - Benthos Abundance and Richness - Offshore Unit vs. BK04

LEVELS ENCOUNTERED DURING PROCESSING ARE:
STATION$

BK04A	EB104	EB106	EB49	EB60	EB67
EB77	EB80	EB85	EB87		

ÄÄ

DEP VAR: LCRSTAB N: 50 MULTIPLE R: 0.849 SQUARED MULTIPLE R: 0.721

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
STATION$	1.412	9	0.157	11.500	0.000
ERROR	0.546	40	0.014		

ÄÄ

COL/ ROW	STATION$
1	BK04A
2	EB104
3	EB106
4	EB49
5	EB60
6	EB67
7	EB77
8	EB80
9	EB85
10	EB87

USING LEAST SQUARES MEANS.

POST HOC TEST OF LCRSTAB
DUNNETT TEST WITH CONTROL = BK04A

ÄÄ
MATRIX OF MEAN DIFFERENCES FROM CONTROL:

1	0.000
2	0.347
3	-0.058
4	-0.038
5	0.330
6	0.204
7	0.414
8	0.164
9	0.368
10	0.274

DUNNETT ONE SIDED TEST.

MATRIX OF PAIRWISE COMPARISON PROBABILITIES:

1	1.000
2	0.000
3	0.487
4	0.499
5	0.000
6	0.028
7	0.000
8	0.089
9	0.000
10	0.002

ÄÄ
LEVELS ENCOUNTERED DURING PROCESSING ARE:
STATION$

```
 BK04A        EB104        EB106        EB49         EB60         EB67
 EB77         EB80         EB85         EB87
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ


DEP VAR: LMOLLAB      N:       50  MULTIPLE R: 0.837  SQUARED MULTIPLE R: 0.701


                        ANALYSIS OF VARIANCE

SOURCE        SUM-OF-SQUARES    DF  MEAN-SQUARE     F-RATIO       P

STATION$               1.665     9        0.185      10.402       0.000

ERROR                  0.711    40        0.018

ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
COL/
ROW STATION$
  1  BK04A
  2  EB104
  3  EB106
  4  EB49
  5  EB60
  6  EB67
  7  EB77
  8  EB80
  9  EB85
 10  EB87

USING LEAST SQUARES MEANS.

POST HOC TEST OF  LMOLLAB
DUNNETT TEST WITH CONTROL = BK04A

ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

MATRIX OF MEAN DIFFERENCES FROM CONTROL:


              1          0.000
              2          0.312
              3          0.040
              4          0.271
              5          0.511
              6          0.339
              7          0.311
              8          0.405
              9          0.512
             10          0.016


 DUNNETT ONE SIDED TEST.
 MATRIX OF PAIRWISE COMPARISON PROBABILITIES:


              1          1.000
              2          0.002
              3          0.500
              4          0.009
              5          0.000
              6          0.001
              7          0.003
              8          0.000
              9          0.000
             10          0.500

ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
LEVELS ENCOUNTERED DURING PROCESSING ARE:
STATION$
 BK04A        EB104        EB106        EB49         EB60         EB67
 EB77         EB80         EB85         EB87
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
```

DEP VAR: LPOLYAB N: 50 MULTIPLE R: 0.856 SQUARED MULTIPLE R: 0.732

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
STATION$	1.023	9	0.114	12.164	0.000
ERROR	0.374	40	0.009		

ÄÄ

COL/
ROW STATION$

COL/ROW	STATION$
1	BK04A
2	EB104
3	EB106
4	EB49
5	EB60
6	EB67
7	EB77
8	EB80
9	EB85
10	EB87

USING LEAST SQUARES MEANS.

POST HOC TEST OF LPOLYAB
DUNNETT TEST WITH CONTROL = BK04A

ÄÄ

MATRIX OF MEAN DIFFERENCES FROM CONTROL:

1	0.000
2	0.226
3	0.031
4	-0.009
5	0.025
6	-0.070
7	0.113
8	-0.080
9	-0.033
10	0.405

DUNNETT ONE SIDED TEST.
MATRIX OF PAIRWISE COMPARISON PROBABILITIES:

1	1.000
2	0.003
3	0.499
4	0.500
5	0.500
6	0.416
7	0.175
8	0.356
9	0.499
10	0.000

ÄÄ

>

```
LEVELS ENCOUNTERED DURING PROCESSING ARE:
STATION$
 BK04A         EB104         EB106         EB49          EB60          EB67
 EB77          EB80          EB85          EB87
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ


DEP VAR: LMISCAB      N:       50  MULTIPLE R: 0.643  SQUARED MULTIPLE R: 0.413

.
                         ANALYSIS OF VARIANCE

SOURCE         SUM-OF-SQUARES   DF  MEAN-SQUARE      F-RATIO        P

STATION$                1.869    9        0.208        3.132      0.006

ERROR                   2.652   40        0.066

ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
COL/
ROW STATION$
  1   BK04A
  2   EB104
  3   EB106
  4   EB49
  5   EB60
  6   EB67
  7   EB77
  8   EB80
  9   EB85
 10   EB87

USING LEAST SQUARES MEANS.

POST HOC TEST OF  LMISCAB
DUNNETT TEST WITH CONTROL = BK04A

ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
MATRIX OF MEAN DIFFERENCES FROM CONTROL:


              1          0.000
              2         -0.247
              3         -0.270
              4         -0.309
              5         -0.048
              6         -0.122
              7         -0.591
              8         -0.480
              9         -0.460
             10         -0.505


DUNNETT ONE SIDED TEST.

MATRIX OF PAIRWISE COMPARISON PROBABILITIES:


              1          1.000
              2          0.285
              3          0.235
              4          0.162
              5          0.500
              6          0.490
              7          0.003
              8          0.018
              9          0.024
             10          0.012

ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
LEVELS ENCOUNTERED DURING PROCESSING ARE:
STATION$
 BK04A         EB104         EB106         EB49          EB60          EB67
 EB77          EB80          EB85          EB87
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
```

DEP VAR: LTABUND N: 50 MULTIPLE R: 0.791 SQUARED MULTIPLE R: 0.626

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
STATION$	0.567	9	0.063	7.433	0.000
ERROR	0.339	40	0.008		

ÄÄ

COL/
ROW STATION$
1 BK04A
2 EB104
3 EB106
4 EB49
5 EB60
6 EB67
7 EB77
8 EB80
9 EB85
10 EB87

USING LEAST SQUARES MEANS.

POST HOC TEST OF LTABUND
DUNNETT TEST WITH CONTROL = BK04A

ÄÄ

MATRIX OF MEAN DIFFERENCES FROM CONTROL:

1	0.000
2	0.266
3	0.002
4	0.102
5	0.311
6	0.167
7	0.234
8	0.192
9	0.298
10	0.219

DUNNETT ONE SIDED TEST.
MATRIX OF PAIRWISE COMPARISON PROBABILITIES:

1	1.000
2	0.000
3	0.500
4	0.207
5	0.000
6	0.022
7	0.001
8	0.007
9	0.000
10	0.002

ÄÄ
LEVELS ENCOUNTERED DURING PROCESSING ARE:
STATION$
BK04A EB104 EB106 EB49 EB60 EB67
EB77 EB80 EB85 EB87
ÄÄ

DEP VAR: TRICH N: 50 MULTIPLE R: 0.805 SQUARED MULTIPLE R: 0.648

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
STATION$	6191.280	9	687.920	8.199	0.000
ERROR	3356.000	40	83.900		

ÄÄ

COL/
ROW STATION$

1	BK04A
2	EB104
3	EB106
4	EB49
5	EB60
6	EB67
7	EB77
8	EB80
9	EB85
10	EB87

USING LEAST SQUARES MEANS.

POST HOC TEST OF TRICH
DUNNETT TEST WITH CONTROL = BK04A

ÄÄ

MATRIX OF MEAN DIFFERENCES FROM CONTROL:

1	0.000
2	22.800
3	-4.000
4	0.200
5	-3.200
6	-6.400
7	0.400
8	-11.600
9	-2.400
10	23.400

DUNNETT ONE SIDED TEST.
MATRIX OF PAIRWISE COMPARISON PROBABILITIES:

1	1.000
2	0.001
3	0.494
4	0.500
5	0.499
6	0.425
7	0.500
8	0.135
9	0.500
10	0.001

ÄÄ

>

Effects coding used for categorical variables in model.

Categorical values encountered during processing are:
STATION$ (10 levels)
BK04A, EB104, EB106, EB49, EB60, EB67, EB77, EB80, EB85, EB87

Dep Var: TCRSTRC N: 50 Multiple R: 0.725 Squared multiple R: 0.525

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
STATION$	710.320	9	78.924	4.917	0.000
Error	642.000	40	16.050		

COL/
ROW STATION$
1 BK04A
2 EB104
3 EB106
4 EB49
5 EB60
6 EB67
7 EB77
8 EB80
9 EB85
10 EB87
Using least squares means.
Post Hoc test of TCRSTRC
Dunnett Test with control = 1.000

Using model MSE of 16.050 with 40 df.
Matrix of mean differences from control:

1	0.0
2	8.000
3	0.200
4	-4.200
5	-3.600
6	-0.400
7	-1.800
8	-1.400
9	2.600
10	6.200

Dunnett One Sided Test.
Matrix of pairwise comparison probabilities:

1	1.000
2	0.011
3	0.500
4	0.235
5	0.318
6	0.500
7	0.493
8	0.499
9	0.446
10	0.057

Effects coding used for categorical variables in model.

Categorical values encountered during processing are:
STATION$ (10 levels)
BK04A, EB104, EB106, EB49, EB60, EB67, EB77, EB80, EB85, EB87

Dep Var: TMOLLRC N: 50 Multiple R: 0.586 Squared multiple R: 0.344

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
STATION$	125.200	9	13.911	2.330	0.032

```
Error                    238.800    40        5.970

-------------------------------------------------------------------------------

COL/
ROW STATION$
  1  BK04A
  2  EB104
  3  EB106
  4  EB49
  5  EB60
  6  EB67
  7  EB77
  8  EB80
  9  EB85
 10  EB87
Using least squares means.
Post Hoc test of TMOLLRC
Dunnett Test with control =        1.000
-------------------------------------------------------------------------------

Using model MSE of 5.970 with 40 df.
Matrix of mean differences from control:
               1           0.0
               2          -1.200
               3          -4.000
               4          -2.000
               5          -0.800
               6          -4.000
               7          -2.200
               8          -5.400
               9          -3.000
              10          -3.400

Dunnett One Sided Test.
Matrix of pairwise comparison probabilities:

               1           1.000
               2           0.488
               3           0.042
               4           0.364
               5           0.499
               6           0.042
               7           0.317
               8           0.004
               9           0.150
              10           0.094
-------------------------------------------------------------------------------


Effects coding used for categorical variables in model.

Categorical values encountered during processing are:
STATION$ (10 levels)
   BK04A, EB104, EB106, EB49, EB60, EB67, EB77, EB80, EB85, EB87

Dep Var: TPOLYRC    N: 50   Multiple R: 0.807   Squared multiple R: 0.651


                          Analysis of Variance

Source              Sum-of-Squares   df  Mean-Square     F-ratio       P

STATION$                  3077.620    9      341.958       8.306      0.000

Error                     1646.800   40       41.170

-------------------------------------------------------------------------------

COL/
ROW STATION$
  1  BK04A
  2  EB104
  3  EB106
  4  EB49
  5  EB60
  6  EB67
  7  EB77
  8  EB80
```

```
 9  EB85
10  EB87
Using least squares means.
Post Hoc test of TPOLYRC
Dunnett Test with control =        1.000
-------------------------------------------------------------------------------

Using model MSE of 41.170 with 40 df.
Matrix of mean differences from control:
                1          0.0
                2         17.000
                3         -1.600
                4          4.600
                5          1.400
                6         -2.000
                7          6.600
                8         -4.000
                9         -0.800
               10         20.200

Dunnett One Sided Test.
Matrix of pairwise comparison probabilities:

                1          1.000
                2          0.001
                3          0.500
                4          0.417
                5          0.500
                6          0.499
                7          0.245
                8          0.455
                9          0.500
               10          0.000
-------------------------------------------------------------------------------


Effects coding used for categorical variables in model.

Categorical values encountered during processing are:
STATION$ (10 levels)
   BK04A, EB104, EB106, EB49, EB60, EB67, EB77, EB80, EB85, EB87

Dep Var: TMISCRC   N: 50   Multiple R: 0.611   Squared multiple R: 0.374


                         Analysis of Variance

Source             Sum-of-Squares   df  Mean-Square     F-ratio       P

STATION$                   64.980    9        7.220       2.654       0.016

Error                     108.800   40        2.720

-------------------------------------------------------------------------------

COL/
ROW STATION$
  1  BK04A
  2  EB104
  3  EB106
  4  EB49
  5  EB60
  6  EB67
  7  EB77
  8  EB80
  9  EB85
 10  EB87
Using least squares means.
Post Hoc test of TMISCRC
Dunnett Test with control =        1.000
-------------------------------------------------------------------------------

Using model MSE of 2.720 with 40 df.
Matrix of mean differences from control:
                1          0.0
                2         -1.000
                3          1.400
                4          1.800
                5         -0.200
                6          0.0
```

7	-2.200
8	-0.800
9	-1.200
10	0.400

Dunnett One Sided Test.
Matrix of pairwise comparison probabilities:

1	1.000
2	0.461
3	0.347
4	0.212
5	0.500
6	0.500
7	0.111
8	0.489
9	0.411
10	0.500

>

ANOVA with Tukey's

ANOVA w/Tukey's - Benthic Abundance and Richness - Offshore Unit stations only

Categorical values encountered during processing are:
STATION$ (9 levels)
EB104, EB106, EB49, EB60, EB67, EB77, EB80, EB85, EB87

Dep Var: LCRSTAB N: 45 Multiple R: 0.834 Squared multiple R: 0.696

Estimates of effects $B = (X'X)^{-1} X'Y'$

		LCRSTAB
CONSTANT		2.337
STATION$	EB104	0.124
STATION$	EB106	-0.281
STATION$	EB49	-0.261
STATION$	EB60	0.108
STATION$	EB67	-0.018
STATION$	EB77	0.191
STATION$	EB80	-0.058
STATION$	EB85	0.145

Analysis of Variance

Source	Sum-of-Squares	DF	Mean-Square	F-Ratio	P
STATION$	1.189	8	0.149	10.296	0.000
Error	0.520	36	0.014		

Least squares means.

	LS Mean	SE	N
STATION$ =EB104	2.461	0.054	5
STATION$ =EB106	2.056	0.054	5
STATION$ =EB49	2.076	0.054	5
STATION$ =EB60	2.445	0.054	5
STATION$ =EB67	2.319	0.054	5
STATION$ =EB77	2.528	0.054	5
STATION$ =EB80	2.279	0.054	5
STATION$ =EB85	2.482	0.054	5
STATION$ =EB87	2.389	0.054	5

COL/
ROW STATION$
1 EB104
2 EB106
3 EB49
4 EB60
5 EB67
6 EB77
7 EB80
8 EB85
9 EB87

Using least squares means.
Post Hoc test of LCRSTAB

Using model MSE of 0.014 with 36 DF.
Matrix of pairwise mean differences:

	1	2	3	4	5
1	0.0				

2	-0.405	0.0			
3	-0.385	0.020	0.0		
4	-0.016	0.388	0.369	0.0	
5	-0.142	0.262	0.243	-0.126	0.0
6	0.067	0.472	0.452	0.083	0.209
7	-0.182	0.222	0.203	-0.166	-0.040
8	0.021	0.426	0.406	0.038	0.164
9	-0.072	0.332	0.313	-0.056	0.070
	6	7	8	9	
6	0.0				
7	-0.249	0.0			
8	-0.046	0.204	0.0		
9	-0.139	0.110	-0.094	0.0	

Tukey HSD Multiple Comparisons.
Matrix of pairwise comparison probabilities:

	1	2	3	4	5
1	1.000				
2	0.000	1.000			
3	0.000	1.000	1.000		
4	1.000	0.000	0.001	1.000	
5	0.636	0.034	0.064	0.767	1.000
6	0.993	0.000	0.000	0.971	0.166
7	0.315	0.116	0.196	0.437	1.000
8	1.000	0.000	0.000	1.000	0.457
9	0.988	0.003	0.006	0.998	0.990
	6	7	8	9	
6	1.000				
7	0.052	1.000			
8	1.000	0.191	1.000		
9	0.662	0.871	0.944	1.000	

Categorical values encountered during processing are:
STATION$ (9 levels)
EB104, EB106, EB49, EB60, EB67, EB77, EB80, EB85, EB87

Dep Var: LMOLLAB N: 45 Multiple R: 0.803 Squared multiple R: 0.644

Estimates of effects $B = (X'X)^{-1} X'Y'$

		LMOLLAB
CONSTANT		2.733
STATION$	EB104	0.010
STATION$	EB106	-0.261
STATION$	EB49	-0.031
STATION$	EB60	0.209
STATION$	EB67	0.037
STATION$	EB77	0.009
STATION$	EB80	0.103
STATION$	EB85	0.210

Analysis of Variance

Source	Sum-of-Squares	DF	Mean-Square	F-Ratio	P
STATION$	1.255	8	0.157	8.155	0.000
Error	0.692	36	0.019		

Least squares means.

		LS Mean	SE	N
STATION$	=EB104	2.743	0.062	5

STATION$	=EB106	2.472	0.062	5
STATION$	=EB49	2.702	0.062	5
STATION$	=EB60	2.943	0.062	5
STATION$	=EB67	2.770	0.062	5
STATION$	=EB77	2.742	0.062	5
STATION$	=EB80	2.836	0.062	5
STATION$	=EB85	2.943	0.062	5
STATION$	=EB87	2.448	0.062	5

COL/ ROW	STATION$
1	EB104
2	EB106
3	EB49
4	EB60
5	EB67
6	EB77
7	EB80
8	EB85
9	EB87

Using least squares means.
Post Hoc test of LMOLLAB

Using model MSE of 0.019 with 36 DF.
Matrix of pairwise mean differences:

	1	2	3	4	5
1	0.0				
2	-0.272	0.0			
3	-0.041	0.231	0.0		
4	0.199	0.471	0.240	0.0	
5	0.027	0.298	0.068	-0.172	0.0
6	-0.001	0.270	0.040	-0.201	-0.028
7	0.093	0.365	0.134	-0.106	0.066
8	0.200	0.471	0.241	0.001	0.173
9	-0.296	-0.024	-0.255	-0.495	-0.323

	6	7	8	9
6	0.0			
7	0.094	0.0		
8	0.201	0.107	0.0	
9	-0.294	-0.389	-0.496	0.0

Tukey HSD Multiple Comparisons.
Matrix of pairwise comparison probabilities:

	1	2	3	4	5
1	1.000				
2	0.080	1.000			
3	1.000	0.210	1.000		
4	0.385	0.000	0.171	1.000	
5	1.000	0.039	0.997	0.577	1.000
6	1.000	0.083	1.000	0.376	1.000
7	0.976	0.005	0.835	0.949	0.997
8	0.382	0.000	0.169	1.000	0.573
9	0.042	1.000	0.121	0.000	0.019

	6	7	8	9
6	1.000			
7	0.974	1.000		
8	0.373	0.948	1.000	
9	0.043	0.003	0.000	1.000

Categorical values encountered during processing are:
STATION$ (9 levels)
EB104, EB106, EB49, EB60, EB67, EB77, EB80, EB85, EB87

Dep Var: LPOLYAB N: 45 Multiple R: 0.856 Squared multiple R: 0.733

Estimates of effects $B = (X'X)^{-1} X'Y'$

LPOLYAB

CONSTANT		2.476
STATION$	EB104	0.158
STATION$	EB106	-0.037
STATION$	EB49	-0.076
STATION$	EB60	-0.043
STATION$	EB67	-0.137
STATION$	EB77	0.046
STATION$	EB80	-0.148
STATION$	EB85	-0.100

Analysis of Variance

Source	Sum-of-Squares	DF	Mean-Square	F-Ratio	P
STATION$	1.003	8	0.125	12.384	0.000
Error	0.364	36	0.010		

Least squares means.

		LS Mean	SE	N
STATION$	=EB104	2.634	0.045	5
STATION$	=EB106	2.439	0.045	5
STATION$	=EB49	2.400	0.045	5
STATION$	=EB60	2.433	0.045	5
STATION$	=EB67	2.339	0.045	5
STATION$	=EB77	2.521	0.045	5
STATION$	=EB80	2.328	0.045	5
STATION$	=EB85	2.375	0.045	5
STATION$	=EB87	2.813	0.045	5

COL/
ROW STATION$

1	EB104
2	EB106
3	EB49
4	EB60
5	EB67
6	EB77
7	EB80
8	EB85
9	EB87

Using least squares means.
Post Hoc test of LPOLYAB

Using model MSE of 0.010 with 36 DF.
Matrix of pairwise mean differences:

	1	2	3	4	5
1	0.0				
2	-0.195	0.0			
3	-0.234	-0.039	0.0		
4	-0.201	-0.006	0.034	0.0	
5	-0.295	-0.100	-0.061	-0.094	0.0
6	-0.113	0.082	0.122	0.088	0.182
7	-0.306	-0.111	-0.072	-0.105	-0.011
8	-0.259	-0.064	-0.024	-0.058	0.036
9	0.179	0.374	0.413	0.380	0.474

	6	7	8	9
6	0.0			
7	-0.193	0.0		
8	-0.146	0.047	0.0	
9	0.292	0.485	0.438	0.0

Tukey HSD Multiple Comparisons.
Matrix of pairwise comparison probabilities:

	1	2	3	4	5
1	1.000				
2	0.086	1.000			
3	0.019	0.999	1.000		
4	0.070	1.000	1.000	1.000	
5	0.001	0.812	0.988	0.856	1.000
6	0.700	0.927	0.610	0.896	0.131
7	0.001	0.715	0.966	0.768	1.000
8	0.007	0.983	1.000	0.991	1.000
9	0.147	0.000	0.000	0.000	0.000

	6	7	8	9
6	1.000			
7	0.091	1.000		
8	0.372	0.998	1.000	
9	0.002	0.000	0.000	1.000

Categorical values encountered during processing are:
STATION$ (9 levels)
EB104, EB106, EB49, EB60, EB67, EB77, EB80, EB85, EB87

Dep Var: LMISCAB N: 45 Multiple R: 0.650 Squared multiple R: 0.423

Estimates of effects $B = (X'X)^{-1} X'Y'$

		LMISCAB
CONSTANT		1.366
STATION$	EB104	0.090
STATION$	EB106	0.067
STATION$	EB49	0.028
STATION$	EB60	0.289
STATION$	EB67	0.215
STATION$	EB77	-0.254
STATION$	EB80	-0.143
STATION$	EB85	-0.123

Analysis of Variance

Source	Sum-of-Squares	DF	Mean-Square	F-Ratio	P
STATION$	1.359	8	0.170	3.296	0.006
Error	1.855	36	0.052		

Least squares means.

		LS Mean	SE	N
STATION$	=EB104	1.457	0.102	5
STATION$	=EB106	1.433	0.102	5
STATION$	=EB49	1.395	0.102	5
STATION$	=EB60	1.655	0.102	5
STATION$	=EB67	1.581	0.102	5
STATION$	=EB77	1.112	0.102	5
STATION$	=EB80	1.223	0.102	5
STATION$	=EB85	1.243	0.102	5
STATION$	=EB87	1.198	0.102	5

COL/
ROW STATION$
1 EB104
2 EB106

```
  3  EB49
  4  EB60
  5  EB67
  6  EB77
  7  EB80
  8  EB85
  9  EB87
Using least squares means.
Post Hoc test of LMISCAB
-------------------------------------------------------------------------------

Using model MSE of 0.052 with 36 DF.
Matrix of pairwise mean differences:

                     1           2           3           4           5
           1       0.0
           2      -0.023       0.0
           3      -0.062      -0.039       0.0
           4       0.198       0.222       0.260       0.0
           5       0.125       0.148       0.187      -0.074       0.0
           6      -0.345      -0.322      -0.283      -0.543      -0.469
           7      -0.234      -0.210      -0.172      -0.432      -0.358
           8      -0.213      -0.190      -0.151      -0.412      -0.338
           9      -0.259      -0.236      -0.197      -0.457      -0.383
                     6           7           8           9
           6       0.0
           7       0.111       0.0
           8       0.131       0.020       0.0
           9       0.086      -0.025      -0.045       0.0

Tukey HSD Multiple Comparisons.
Matrix of pairwise comparison probabilities:

                     1           2           3           4           5
           1       1.000
           2       1.000       1.000
           3       1.000       1.000       1.000
           4       0.897       0.828       0.673       1.000
           5       0.993       0.980       0.925       1.000       1.000
           6       0.314       0.403       0.574       0.015       0.053
           7       0.784       0.864       0.953       0.097       0.268
           8       0.855       0.917       0.977       0.131       0.339
           9       0.681       0.777       0.902       0.065       0.194
                     6           7           8           9
           6       1.000
           7       0.997       1.000
           8       0.991       1.000       1.000
           9       1.000       1.000       1.000       1.000
-------------------------------------------------------------------------------


Categorical values encountered during processing are:
STATION$ (9 levels)
   EB104, EB106, EB49, EB60, EB67, EB77, EB80, EB85, EB87

Dep Var: LTABUND N: 45 Multiple R:  0.735 Squared multiple R:  0.540


                                 -1
Estimates of effects  B = (X'X)   X'Y'


                          LTABUND

   CONSTANT                      3.059

   STATION$      EB104           0.067

   STATION$      EB106          -0.197

   STATION$      EB49           -0.098

   STATION$      EB60            0.112

   STATION$      EB67           -0.032

   STATION$      EB77            0.035

   STATION$      EB80           -0.007
```

STATION$ EB85 0.099

Analysis of Variance

Source	Sum-of-Squares	DF	Mean-Square	F-Ratio	P
STATION$	0.389	8	0.049	5.288	0.000
Error	0.331	36	0.009		

Least squares means.

		LS Mean	SE	N
STATION$	=EB104	3.126	0.043	5
STATION$	=EB106	2.862	0.043	5
STATION$	=EB49	2.961	0.043	5
STATION$	=EB60	3.171	0.043	5
STATION$	=EB67	3.027	0.043	5
STATION$	=EB77	3.094	0.043	5
STATION$	=EB80	3.052	0.043	5
STATION$	=EB85	3.158	0.043	5
STATION$	=EB87	3.079	0.043	5

COL/
ROW STATION$

1	EB104
2	EB106
3	EB49
4	EB60
5	EB67
6	EB77
7	EB80
8	EB85
9	EB87

Using least squares means.
Post Hoc test of LTABUND

Using model MSE of 0.009 with 36 DF.
Matrix of pairwise mean differences:

	1	2	3	4	5
1	0.0				
2	-0.264	0.0			
3	-0.164	0.099	0.0		
4	0.045	0.309	0.210	0.0	
5	-0.099	0.165	0.065	-0.144	0.0
6	-0.032	0.232	0.133	-0.077	0.067
7	-0.074	0.190	0.091	-0.119	0.025
8	0.032	0.296	0.196	-0.013	0.131
9	-0.047	0.217	0.118	-0.092	0.052

	6	7	8	9
6	0.0			
7	-0.042	0.0		
8	0.064	0.106	0.0	
9	-0.015	0.027	-0.079	0.0

Tukey HSD Multiple Comparisons.
Matrix of pairwise comparison probabilities:

	1	2	3	4	5
1	1.000				
2	0.003	1.000			
3	0.180	0.780	1.000		
4	0.998	0.000	0.034	1.000	
5	0.781	0.179	0.974	0.325	1.000
6	1.000	0.013	0.432	0.934	0.969
7	0.948	0.074	0.849	0.578	1.000
8	1.000	0.001	0.057	1.000	0.452
9	0.997	0.025	0.590	0.841	0.994

	6	7	8	9
6	1.000			
7	0.999	1.000		
8	0.978	0.718	1.000	
9	1.000	1.000	0.926	1.000

Categorical values encountered during processing are:
STATION$ (9 levels)
EB104, EB106, EB49, EB60, EB67, EB77, EB80, EB85, EB87

Dep Var: TRICH N: 45 Multiple R: 0.819 Squared multiple R: 0.671

Estimates of effects $B = (X'X)^{-1} X'Y'$

		TRICH
CONSTANT		90.333
STATION$	EB104	20.667
STATION$	EB106	-6.133
STATION$	EB49	-1.933
STATION$	EB60	-5.333
STATION$	EB67	-8.533
STATION$	EB77	-1.733
STATION$	EB80	-13.733
STATION$	EB85	-4.533

Analysis of Variance

Source	Sum-of-Squares	DF	Mean-Square	F-Ratio	P
STATION$	6170.800	8	771.350	9.173	0.000
Error	3027.200	36	84.089		

Least squares means.

		LS Mean	SE	N
STATION$	=EB104	111.000	4.101	5
STATION$	=EB106	84.200	4.101	5
STATION$	=EB49	88.400	4.101	5
STATION$	=EB60	85.000	4.101	5
STATION$	=EB67	81.800	4.101	5
STATION$	=EB77	88.600	4.101	5
STATION$	=EB80	76.600	4.101	5
STATION$	=EB85	85.800	4.101	5
STATION$	=EB87	111.600	4.101	5

COL/
ROW STATION$
1 EB104
2 EB106
3 EB49
4 EB60
5 EB67
6 EB77
7 EB80
8 EB85
9 EB87

Using least squares means.
Post Hoc test of TRICH

Using model MSE of 84.089 with 36 DF.
Matrix of pairwise mean differences:

	1	2	3	4	5
1	0.0				

	1	2	3	4	5
2	-26.800	0.0			
3	-22.600	4.200	0.0		
4	-26.000	0.800	-3.400	0.0	
5	-29.200	-2.400	-6.600	-3.200	0.0
6	-22.400	4.400	0.200	3.600	6.800
7	-34.400	-7.600	-11.800	-8.400	-5.200
8	-25.200	1.600	-2.600	0.800	4.000
9	0.600	27.400	23.200	26.600	29.800

	6	7	8	9
6	0.0			
7	-12.000	0.0		
8	-2.800	9.200	0.0	
9	23.000	35.000	25.800	0.0

Tukey HSD Multiple Comparisons.
Matrix of pairwise comparison probabilities:

	1	2	3	4	5
1	1.000				
2	0.002	1.000			
3	0.011	0.998	1.000		
4	0.002	1.000	1.000	1.000	
5	0.001	1.000	0.964	1.000	1.000
6	0.012	0.997	1.000	0.999	0.957
7	0.000	0.922	0.531	0.871	0.992
8	0.003	1.000	1.000	1.000	0.999
9	1.000	0.001	0.008	0.002	0.000

	6	7	8	9
6	1.000			
7	0.509	1.000		
8	1.000	0.806	1.000	
9	0.009	0.000	0.002	1.000

>

Effects coding used for categorical variables in model.

Categorical values encountered during processing are:
STATION$ (9 levels)
EB104, EB106, EB49, EB60, EB67, EB77, EB80, EB85, EB87

Dep Var: TCRSTRC N: 45 Multiple R: 0.731 Squared multiple R: 0.535

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
STATION$	708.578	8	88.572	5.176	0.000
Error	616.000	36	17.111		

COL/
ROW STATION$
1 EB104
2 EB106
3 EB49
4 EB60
5 EB67
6 EB77
7 EB80
8 EB85
9 EB87
Using least squares means.
Post Hoc test of TCRSTRC

Using model MSE of 17.111 with 36 df.
Matrix of pairwise mean differences:

	1	2	3	4	5
1	0.0				
2	-7.800	0.0			
3	-12.200	-4.400	0.0		
4	-11.600	-3.800	0.600	0.0	
5	-8.400	-0.600	3.800	3.200	0.0
6	-9.800	-2.000	2.400	1.800	-1.400
7	-9.400	-1.600	2.800	2.200	-1.000
8	-5.400	2.400	6.800	6.200	3.000
9	-1.800	6.000	10.400	9.800	6.600

	6	7	8	9
6	0.0			
7	0.400	0.0		
8	4.400	4.000	0.0	
9	8.000	7.600	3.600	0.0

Tukey HSD Multiple Comparisons.
Matrix of pairwise comparison probabilities:

	1	2	3	4	5
1	1.000				
2	0.103	1.000			
3	0.001	0.753	1.000		
4	0.002	0.869	1.000	1.000	
5	0.061	1.000	0.869	0.946	1.000
6	0.016	0.997	0.990	0.999	1.000
7	0.024	0.999	0.975	0.995	1.000
8	0.512	0.990	0.222	0.330	0.962
9	0.999	0.372	0.009	0.016	0.255

	6	7	8	9
6	1.000			
7	1.000	1.000		
8	0.753	0.835	1.000	
9	0.087	0.121	0.899	1.000

Effects coding used for categorical variables in model.

Categorical values encountered during processing are:
STATION$ (9 levels)
EB104, EB106, EB49, EB60, EB67, EB77, EB80, EB85, EB87

Dep Var: TMOLLRC   N: 45   Multiple R: 0.561   Squared multiple R: 0.315

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
STATION$	87.644	8	10.956	2.067	0.066
Error	190.800	36	5.300		

COL/
ROW STATION$
1 EB104
2 EB106
3 EB49
4 EB60
5 EB67
6 EB77
7 EB80
8 EB85
9 EB87

Using least squares means.
Post Hoc test of TMOLLRC

Using model MSE of 5.300 with 36 df.
Matrix of pairwise mean differences:

	1	2	3	4	5
1	0.0				
2	-2.800	0.0			
3	-0.800	2.000	0.0		
4	0.400	3.200	1.200	0.0	
5	-2.800	0.0	-2.000	-3.200	0.0
6	-1.000	1.800	-0.200	-1.400	1.800
7	-4.200	-1.400	-3.400	-4.600	-1.400
8	-1.800	1.000	-1.000	-2.200	1.000
9	-2.200	0.600	-1.400	-2.600	0.600

	6	7	8	9
6	0.0			
7	-3.200	0.0		
8	-0.800	2.400	0.0	
9	-1.200	2.000	-0.400	0.0

Tukey HSD Multiple Comparisons.
Matrix of pairwise comparison probabilities:

	1	2	3	4	5
1	1.000				
2	0.603	1.000			
3	1.000	0.900	1.000		
4	1.000	0.428	0.995	1.000	
5	0.603	1.000	0.900	0.428	1.000
6	0.999	0.943	1.000	0.987	0.943
7	0.127	0.987	0.349	0.069	0.987
8	0.943	0.999	0.999	0.843	0.999
9	0.843	1.000	0.987	0.691	1.000

	6	7	8	9
6	1.000			
7	0.428	1.000		
8	1.000	0.772	1.000	
9	0.995	0.900	1.000	1.000

Effects coding used for categorical variables in model.

Categorical values encountered during processing are:
STATION$ (9 levels)
EB104, EB106, EB49, EB60, EB67, EB77, EB80, EB85, EB87

Dep Var: TPOLYRC   N: 45   Multiple R: 0.814   Squared multiple R: 0.663

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
STATION$	2982.400	8	372.800	8.867	0.000
Error	1513.600	36	42.044		

COL/
ROW STATION$
1 EB104
2 EB106
3 EB49
4 EB60
5 EB67
6 EB77
7 EB80
8 EB85
9 EB87
Using least squares means.
Post Hoc test of TPOLYRC

Using model MSE of 42.044 with 36 df.
Matrix of pairwise mean differences:

	1	2	3	4	5
1	0.0				
2	-18.600	0.0			
3	-12.400	6.200	0.0		
4	-15.600	3.000	-3.200	0.0	
5	-19.000	-0.400	-6.600	-3.400	0.0
6	-10.400	8.200	2.000	5.200	8.600
7	-21.000	-2.400	-8.600	-5.400	-2.000
8	-17.800	0.800	-5.400	-2.200	1.200
9	3.200	21.800	15.600	18.800	22.200
	6	7	8	9	
6	0.0				
7	-10.600	0.0			
8	-7.400	3.200	0.0		
9	13.600	24.200	21.000	0.0	

Tukey HSD Multiple Comparisons.
Matrix of pairwise comparison probabilities:

	1	2	3	4	5
1	1.000				
2	0.002	1.000			
3	0.094	0.843	1.000		
4	0.014	0.998	0.997	1.000	
5	0.001	1.000	0.794	0.995	1.000
6	0.249	0.554	1.000	0.934	0.491
7	0.000	1.000	0.491	0.920	1.000
8	0.003	1.000	0.920	1.000	1.000
9	0.997	0.000	0.014	0.002	0.000
	6	7	8	9	
6	1.000				
7	0.228	1.000			
8	0.679	0.997	1.000		
9	0.048	0.000	0.000	1.000	

Effects coding used for categorical variables in model.

Categorical values encountered during processing are:
STATION$ (9 levels)
EB104, EB106, EB49, EB60, EB67, EB77, EB80, EB85, EB87

Dep Var: TMISCRC N: 45 Multiple R: 0.623 Squared multiple R: 0.388

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
STATION$	64.800	8	8.100	2.859	0.014
Error	102.000	36	2.833		

COL/
ROW STATION$
1 EB104
2 EB106
3 EB49
4 EB60
5 EB67
6 EB77
7 EB80
8 EB85
9 EB87

Using least squares means.
Post Hoc test of TMISCRC

Using model MSE of 2.833 with 36 df.
Matrix of pairwise mean differences:

	1	2	3	4	5
1	0.0				
2	2.400	0.0			
3	2.800	0.400	0.0		
4	0.800	-1.600	-2.000	0.0	
5	1.000	-1.400	-1.800	0.200	0.0
6	-1.200	-3.600	-4.000	-2.000	-2.200
7	0.200	-2.200	-2.600	-0.600	-0.800
8	-0.200	-2.600	-3.000	-1.000	-1.200
9	1.400	-1.000	-1.400	0.600	0.400

	6	7	8	9
6	0.0			
7	1.400	0.0		
8	1.000	-0.400	0.0	
9	2.600	1.200	1.600	0.0

Tukey HSD Multiple Comparisons.
Matrix of pairwise comparison probabilities:

	1	2	3	4	5
1	1.000				
2	0.395	1.000			
3	0.210	1.000	1.000		
4	0.998	0.847	0.632	1.000	
5	0.989	0.920	0.748	1.000	1.000
6	0.966	0.041	0.016	0.632	0.510
7	1.000	0.510	0.293	1.000	0.998
8	1.000	0.293	0.145	0.989	0.966
9	0.920	0.989	0.920	1.000	1.000

	6	7	8	9
6	1.000			
7	0.920	1.000		
8	0.989	1.000	1.000	
9	0.293	0.966	0.847	1.000

>

Summary Anova Results for Benthic Comparisons

Table K.5-1—Probability of Significant Differences Among Station Pairs Based on Mean Crustacean Abundance ANOVAs

Station	Among Station Comparisons Using Only Marine Sediments Unit Stations[a]								Comparison Between Marine Sed Unit Background Station[b]
	EB49	EB60	EB67	EB77	EB80	EB85	EB87	EB104	BK04 (Alki)
EB49									<0.499
EB60	**<0.001**								**<0.001**
EB67	**<0.064**	<0.767							**<0.028**
EB77	**<0.001**	<0.971	<0.166						**<0.001**
EB80	<0.196	<0.437	<1.000	**<0.052**					**<0.089**
EB85	**<0.001**	<1.000	<0.457	<1.000	<0.191				**<0.001**
EB87	**<0.006**	<0.998	<0.990	<0.662	<0.871	<0.944			**<0.002**
EB104	**<0.001**	<1.000	<0.636	<0.993	<0.315	<1.000	<0.988		**<0.001**
EB106	<1.000	**<0.001**	**<0.034**	**<0.001**	<0.116	**<0.001**	**<0.003**	**<0.001**	<0.487

[a]Probabilities based on Tukey's *a posteriori* contrasts
[b]Probabilities based on Dunnett's *a posteriori* contrasts
Shaded values statistically significantly (P<0.10) different

Table K.5-2—Probability of Significant Differences Among Station Pairs Based on Mean Mollusc Abundance ANOVAs

Station	Among Station Comparisons Using Only Marine Sediments Unit Stations[a]								Comparison Between Marine Sed Unit and Background Station[b] BK04 (Alki)
	EB49	EB60	EB67	EB77	EB80	EB85	EB87	EB104	
EB49									**<0.009**
EB60	<0.171								**<0.001**
EB67	<0.997	<0.577							**<0.001**
EB77	<1.000	<0.376	<1.000						**<0.003**
EB80	<0.835	<0.949	<0.997	<0.974					**<0.001**
EB85	<0.169	<1.000	<0.573	<0.373	<0.948				**<0.001**
EB87	<0.121	**<0.001**	**<0.019**	**<0.043**	**<0.003**	**<0.001**			<0.500
EB104	<1.000	<0.385	<1.000	<1.000	<0.976	<0.382	**<0.042**		**<0.002**
EB106	<0.210	**<0.001**	**<0.039**	**<0.083**	**<0.005**	**<0.001**	<1.000	**<0.080**	<0.500

[a]Probabilities based on Tukey's *a posteriori* contrasts
[b]Probabilities based on Dunnett's *a posteriori* contrasts
Shaded values statistically significantly (P<0.10) different

Table K.5-3—Probability of Significant Differences Among Station Pairs Based on Mean Polychaete Abundance ANOVAs

Station	Among Station Comparisons Using Only Marine Sediments Unit Stations[a]								Comparison Between Marine Sed Unit and Background Station[b] BK04 (Alki)
	EB49	EB60	EB67	EB77	EB80	EB85	EB87	EB104	
EB49									<0.500
EB60	<1.000								<0.500
EB67	<0.988	<0.856							<0.416
EB77	<0.610	<0.896	<0.131						<0.175
EB80	<0.966	<0.768	<1.000	**<0.091**					<0.356
EB85	<1.000	<0.991	<1.000	<0.372	<0.998				<0.499
EB87	**<0.001**	**<0.001**	**<0.001**	**<0.002**	**<0.001**	**<0.001**			**<0.001**
EB104	**<0.019**	**<0.070**	**<0.001**	<0.700	**<0.001**	**<0.007**	<0.147		**<0.003**
EB106	<0.999	<1.000	<0.812	<0.927	<0.715	<0.983	**<0.001**	**<0.086**	<0.499

[a]Probabilities based on Tukey's *a posteriori* contrasts
[b]Probabilities based on Dunnett's *a posteriori* contrasts
Shaded values statistically significantly (P<0.10) different

Table K.5-4—Probability of Significant Differences Among Station Pairs Based on Mean Miscellaneous Taxa Abundance ANOVAs

Station	Among Station Comparisons Using Only Marine Sediments Unit Stations[a]								Comparison Between Marine Sed Unit and Background Station[b]
	EB49	EB60	EB67	EB77	EB80	EB85	EB87	EB104	BK04 (Alki)
EB49									<0.162
EB60	<0.673								<0.500
EB67	<0.925	<1.000							<0.490
EB77	<0.574	**<0.015**	**<0.053**						**<0.003**
EB80	<0.953	**<0.097**	<0.268	<0.997					**<0.018**
EB85	<0.977	<0.131	<0.339	<0.991	<1.000				**<0.024**
EB87	<0.902	**<0.065**	<0.194	<1.000	<1.000	<1.000			**<0.012**
EB104	<1.000	<0.897	<0.993	<0.314	<0.784	<0.855	<0.681		<0.285
EB106	<1.000	<0.828	<0.980	<0.403	<0.864	<0.917	<0.777	<1.000	<0.235

[a]Probabilities based on Tukey's *a posteriori* contrasts
[b]Probabilities based on Dunnett's *a posteriori* contrasts
Shaded values statistically significantly (P<0.10) different

Table K.5-5—Probability of Significant Differences Among Station Pairs Based on Total Abundance ANOVAs

Station	Among Station Comparisons Using Only Marine Sediments Unit Stations[a]								Comparison Between Marine Sed Unit and Background Station[b]
	EB49	EB60	EB67	EB77	EB80	EB85	EB87	EB104	BK04 (Alki)
EB49									<0.207
EB60	**<0.034**								**<0.001**
EB67	<0.974	<0.325							**<0.022**
EB77	<0.432	<0.934	<0.969						**<0.001**
EB80	<0.849	<0.578	<1.000	<0.999					**<0.007**
EB85	**<0.057**	<1.000	<0.452	<0.978	<0.718				**<0.001**
EB87	<0.590	<0.841	<0.994	<1.000	<1.000	<0.926			**<0.002**
EB104	<0.180	<0.998	<0.781	<1.000	<0.948	<1.000	<0.997		**<0.001**
EB106	<0.780	**<0.001**	<0.179	**<0.013**	**<0.074**	**<0.001**	**<0.025**	**<0.003**	<0.500

[a]Probabilities based on Tukey's *a posteriori* contrasts
[b]Probabilities based on Dunnett's *a posteriori* contrasts
Shaded values statistically significantly (P<0.10) different

Table K.5-6—Probability of Significant Differences Among Station Pairs Based on Mean Total Richness ANOVAs

Station	Among Station Comparisons Using Only Marine Sediments Unit Stations[a]								Comparison Between Marine Sed Unit and Background Station[b]
	EB49	EB60	EB67	EB77	EB80	EB85	EB87	EB104	BK04 (Alki)
EB49									<0.500
EB60	<1.000								<0.499
EB67	<0.964	<1.000							<0.425
EB77	<1.000	<0.999	<0.957						<0.500
EB80	<0.531	<0.871	<0.992	<0.509					<0.135
EB85	<1.000	<1.000	<0.999	<1.000	<0.806				<0.500
EB87	**<0.008**	**<0.002**	**<0.001**	**<0.009**	**<0.001**	**<0.002**			**<0.001**
EB104	**<0.011**	**<0.002**	**<0.001**	**<0.012**	**<0.001**	**<0.003**	<1.000		**<0.001**
EB106	<0.998	<1.000	<1.000	<0.997	<0.922	<1.000	**<0.001**	**<0.002**	<0.494

[a]Probabilities based on Tukey's *a posteriori* contrasts
[b]Probabilities based on Dunnett's *a posteriori* contrasts
Shaded values statistically significantly (P<0.10) different

Table K.5-7—Probability of Significant Differences Among Station Pairs Based on Mean Crustacean Richness ANOVAs

Station	Among Station Comparisons Using Only Marine Sediments Unit Stations[a]								Comparison Between Marine Sed Unit and Background Station[b]
	EB49	EB60	EB67	EB77	EB80	EB85	EB87	EB104	BK04 (Alki)
EB49									<0.235
EB60	<1.000								<0.318
EB67	<0.869	<0.946							<0.500
EB77	<0.990	<0.999	<1.000						<0.493
EB80	<0.975	<0.995	<1.000	<1.000					<0.499
EB85	<0.222	<0.330	<0.962	<0.753	<0.835				<0.446
EB87	**<0.009**	**<0.016**	<0.255	**<0.087**	<0.121	<0.899			**<0.057**
EB104	**<0.001**	**<0.002**	**<0.061**	**<0.016**	**<0.024**	<0.512	<0.999		**<0.011**
EB106	<0.753	<0.869	<1.000	<0.997	<0.999	<0.990	<0.372	<0.103	<0.500

[a]Probabilities based on Tukey's *a posteriori* contrasts
[b]Probabilities based on Dunnett's *a posteriori* contrasts
Shaded values statistically significantly (P<0.10) different

Table K.5-8—Probability of Significant Differences Among Station Pairs Based on Mean Mollusc Richness ANOVAs

Station	Among Station Comparisons Using Only Marine Sediments Unit Stations[a]								Comparison Between Marine Sed Unit and Background Station[b]
	EB49	EB60	EB67	EB77	EB80	EB85	EB87	EB104	BK04 (Alki)
EB49									<0.364
EB60	<0.995								<0.499
EB67	<0.900	<0.428							**<0.042**
EB77	<1.000	<0.987	<0.943						<0.317
EB80	<0.349	**<0.069**	<0.987	<0.428					**<0.004**
EB85	<0.999	<0.843	<0.999	<1.000	<0.772				<0.150
EB87	<0.987	<0.691	<1.000	<0.995	<0.900	<1.000			**<0.094**
EB104	<1.000	<1.000	<0.603	<0.999	<0.127	<0.943	<0.843		<0.488
EB106	<0.900	<0.428	<1.000	<0.943	<0.987	<0.999	<1.000	<0.603	**<0.042**

[a]Probabilities based on Tukey's *a posteriori* contrasts
[b]Probabilities based on Dunnett's *a posteriori* contrasts
Shaded values statistically significantly (P<0.10) different

Table K.5-9—Probability of Significant Differences Among Station Pairs Based on Mean Polychaete Richness ANOVAs

Station	Among Station Comparisons Using Only Marine Sediments Unit Stations[a]								Comparison Between Marine Sed Unit and Background Station[b]
	EB49	EB60	EB67	EB77	EB80	EB85	EB87	EB104	BK04 (Alki)
EB49									<0.417
EB60	<0.997								<0.500
EB67	<0.794	<0.995							<0.499
EB77	<1.000	<0.934	<0.491						<0.245
EB80	<0.491	<0.920	<1.000	<0.228					<0.455
EB85	<0.920	<1.000	<1.000	<0.679	<0.997				<0.500
EB87	**<0.014**	**<0.002**	**<0.001**	**<0.048**	**<0.001**	**<0.001**			**<0.001**
EB104	**<0.094**	**<0.014**	**<0.001**	<0.249	**<0.001**	**<0.003**	<0.997		**<0.001**
EB106	<0.843	<0.998	<1.000	<0.554	<1.000	<1.000	**<0.001**	**<0.002**	<0.500

[a]Probabilities based on Tukey's *a posteriori* contrasts
[b]Probabilities based on Dunnett's *a posteriori* contrasts
Shaded values statistically significantly (P<0.10) different

Table K.5-10—Probability of Significant Differences Among Station Pairs Based on Mean Miscellaneous Taxa Richness ANOVAs

Station	Among Station Comparisons Using Only Marine Sediments Unit Stations[a]								Comparison Between Marine Sed Unit and Background Station[b]
	EB49	EB60	EB67	EB77	EB80	EB85	EB87	EB104	BK04 (Alki)
EB49									<0.212
EB60	<0.632								<0.500
EB67	<0.748	<1.000							<0.500
EB77	**<0.016**	<0.632	<0.510						<0.111
EB80	<0.293	<1.000	<0.998	<0.920					<0.489
EB85	<0.145	<0.989	<0.966	<0.989	<1.000				<0.411
EB87	<0.920	<1.000	<1.000	<0.293	<0.966	<0.847			<0.500
EB104	<0.210	<0.998	<0.989	<0.966	<1.000	<1.000	<0.920		<0.461
EB106	<1.000	<0.847	<0.920	**<0.041**	<0.510	<0.293	<0.989	<0.395	<0.347

[a]Probabilities based on Tukey's *a posteriori* contrasts
[b]Probabilities based on Dunnett's *a posteriori* contrasts
Shaded values statistically significantly (P<0.10) different

Bray-Curtis Classification Analysis

Data matrix read from: trclust.dat

Number of communities = 11
Number of taxa = 214

Number of samples/community:

5 5 5 5 5 5 5 5 5 5 5

Average Data Matrix

EB049	EB060	EB067	EB077	EB080	EB085
.2302E+01	.2724E+01	.2540E+01	.2316E+01	.2564E+01	.2578E+01
.1972E+01	.2208E+01	.1952E+01	.2092E+01	.1822E+01	.2050E+01
.1092E+01	.1686E+01	.2086E+01	.2246E+01	.2260E+01	.2452E+01
.8320E+00	.1854E+01	.1940E+01	.2230E+01	.1932E+01	.2128E+01
.1668E+01	.2078E+01	.1454E+01	.1358E+01	.1794E+01	.2022E+01
.2112E+01	.1984E+01	.1236E+01	.1308E+01	.1206E+01	.1402E+01
.1306E+01	.1424E+01	.1196E+01	.1666E+01	.1282E+01	.1450E+01
.6080E+00	.1786E+01	.1662E+01	.1776E+01	.1514E+01	.1744E+01
.1592E+01	.3720E+00	.5300E+00	.8040E+00	.5680E+00	.7740E+00
.7440E+00	.1234E+01	.1238E+01	.9020E+00	.7620E+00	.8200E+00
.6000E-01	.1254E+01	.1010E+01	.1542E+01	.9380E+00	.1142E+01
.1374E+01	.1204E+01	.8740E+00	.9640E+00	.7600E+00	.8480E+00
.2400E+00	.0000E+00	.0000E+00	.0000E+00	.1200E+00	.0000E+00
.4080E+00	.1320E+01	.9620E+00	.1192E+01	.4320E+00	.1036E+01
.1146E+01	.7460E+00	.6900E+00	.9760E+00	.9180E+00	.8920E+00
.6000E-01	.7400E+00	.6840E+00	.1322E+01	.9360E+00	.1282E+01
[illegible]700E+00	.1024E+01	.6100E+00	.1054E+01	.4520E+00	.8340E+00
.5100E+00	.0000E+00	.0000E+00	.0000E+00	.1200E+00	.0000E+00
.9400E+00	.1040E+01	.1072E+01	.1018E+01	.9520E+00	.9020E+00
.1690E+01	.5180E+00	.4800E+00	.5760E+00	.2800E+00	.3360E+00
.1052E+01	.6660E+00	.6240E+00	.6900E+00	.8160E+00	.5960E+00
.6820E+00	.5920E+00	.1006E+01	.1114E+01	.9240E+00	.1056E+01
.0000E+00	.0000E+00	.0000E+00	.6000E-01	.1560E+00	.0000E+00
.8560E+00	.5480E+00	.3960E+00	.4160E+00	.5500E+00	.3460E+00
.9540E+00	.1198E+01	.7520E+00	.1026E+01	.5160E+00	.7760E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.4660E+00	.9660E+00	.8360E+00	.8980E+00	.9200E+00	.9700E+00
.6000E-01	.3720E+00	.1092E+01	.9080E+00	.4700E+00	.5120E+00
.2960E+00	.9880E+00	.6000E+00	.1042E+01	.9660E+00	.1100E+01
.8100E+00	.8860E+00	.7360E+00	.4760E+00	.4880E+00	.7280E+00
.5120E+00	.3000E+00	.4500E+00	.9220E+00	.7300E+00	.4760E+00
.5440E+00	.1072E+01	.8180E+00	.2520E+00	.3480E+00	.5360E+00
.1102E+01	.3360E+00	.3720E+00	.3360E+00	.6160E+00	.2160E+00
.8020E+00	.9860E+00	.6220E+00	.1098E+01	.6820E+00	.1086E+01
.5720E+00	.3560E+00	.3360E+00	.9180E+00	.5360E+00	.8760E+00
.6220E+00	.4320E+00	.4320E+00	.6420E+00	.9580E+00	.6920E+00
.1200E+00	.3600E+00	.6620E+00	.8660E+00	.7280E+00	.6920E+00
.5060E+00	.3200E+00	.3120E+00	.1800E+00	.6000E-01	.4680E+00
.1118E+01	.3560E+00	.1920E+00	.9600E-01	.6000E-01	.6000E-01
.2520E+00	.7660E+00	.8780E+00	.6760E+00	.5840E+00	.7920E+00
.2160E+00	.6000E-01	.9600E-01	.1200E+00	.9600E-01	.6000E-01
[illegible]260E+00	.8880E+00	.4160E+00	.2160E+00	.3560E+00	.2760E+00
.6000E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.6000E-01	.0000E+00	.1800E+00	.0000E+00	.6000E-01
.0000E+00	.2760E+00	.2520E+00	.7280E+00	.3120E+00	.9560E+00
.0000E+00	.9600E-01	.0000E+00	.2160E+00	.1200E+00	.6000E-01

.1200E+00	.1560E+00	.4920E+00	.7920E+00	.1700E+00	.8180E+00
.2520E+00	.3700E+00	.0000E+00	.0000E+00	.0000E+00	.2600E+00
.8420E+00	.3600E+00	.5400E+00	.9600E-01	.6000E-01	.3720E+00
.4560E+00	.3560E+00	.2520E+00	.5520E+00	.1200E+00	.2760E+00
.4660E+00	.3360E+00	.1560E+00	.9600E-01	.3620E+00	.1200E+00
.1200E+00	.2760E+00	.5260E+00	.8480E+00	.3360E+00	.3720E+00
.0000E+00	.6080E+00	.0000E+00	.0000E+00	.0000E+00	.2000E+00
.7780E+00	.1800E+00	.4920E+00	.1200E+00	.2160E+00	.3360E+00
.2400E+00	.4400E+00	.4920E+00	.6000E+00	.2400E+00	.5660E+00
.5600E+00	.6660E+00	.4920E+00	.1800E+00	.8420E+00	.2960E+00
.5520E+00	.2760E+00	.0000E+00	.1200E+00	.2600E+00	.1200E+00
.1262E+01	.2160E+00	.6000E-01	.6000E-01	.0000E+00	.0000E+00
.8100E+00	.6360E+00	.1800E+00	.6000E-01	.2160E+00	.3360E+00
.3960E+00	.3120E+00	.4680E+00	.4760E+00	.7560E+00	.2600E+00
.2600E+00	.2160E+00	.6000E-01	.5860E+00	.1560E+00	.2400E+00
.6000E-01	.3360E+00	.4080E+00	.8700E+00	.6000E-01	.7080E+00
.5260E+00	.9600E-01	.2520E+00	.1900E+00	.1200E+00	.1560E+00
.6000E-01	.1200E+00	.3320E+00	.6160E+00	.2520E+00	.5300E+00
.6000E-01	.6560E+00	.5660E+00	.4320E+00	.5400E+00	.4960E+00
.1800E+00	.3920E+00	.6120E+00	.3120E+00	.7100E+00	.3600E+00
.1200E+00	.6000E-01	.4080E+00	.5640E+00	.1560E+00	.6840E+00
.2600E+00	.4800E+00	.2400E+00	.4160E+00	.6000E-01	.6560E+00
.5120E+00	.5720E+00	.2160E+00	.3920E+00	.1560E+00	.1560E+00
.0000E+00	.5800E+00	.3900E+00	.1200E+00	.2160E+00	.9600E-01
.2400E+00	.3480E+00	.1200E+00	.3560E+00	.6000E-01	.6000E-01
.9040E+00	.3720E+00	.1560E+00	.0000E+00	.1200E+00	.6000E-01
.2160E+00	.6080E+00	.3360E+00	.3960E+00	.2400E+00	.4080E+00
.4440E+00	.4400E+00	.2160E+00	.2760E+00	.5360E+00	.3000E+00
.1200E+00	.3120E+00	.2160E+00	.7080E+00	.2960E+00	.5520E+00
.4660E+00	.5300E+00	.1560E+00	.5720E+00	.6000E-01	.4760E+00
.0000E+00	.9600E-01	.4860E+00	.3160E+00	.0000E+00	.2160E+00
.2000E+00	.4320E+00	.0000E+00	.9600E-01	.2160E+00	.6000E-01
.5360E+00	.4560E+00	.1200E+00	.3800E+00	.3480E+00	.1560E+00
.0000E+00	.1200E+00	.3920E+00	.3720E+00	.2000E+00	.6000E-01
.3560E+00	.3480E+00	.1200E+00	.2160E+00	.1800E+00	.2760E+00
.0000E+00	.4020E+00	.5720E+00	.2160E+00	.3360E+00	.2760E+00
.6000E-01	.0000E+00	.1200E+00	.6000E-01	.6000E-01	.6000E-01
.6000E-01	.0000E+00	.3920E+00	.3000E+00	.1200E+00	.1800E+00
.5920E+00	.6000E-01	.0000E+00	.1800E+00	.6000E-01	.6000E-01
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.3320E+00	.0000E+00	.9600E-01	.9600E-01	.9600E-01	.1560E+00
.5460E+00	.3000E+00	.3720E+00	.2760E+00	.3000E+00	.3320E+00
.4160E+00	.1560E+00	.1200E+00	.4900E+00	.0000E+00	.6000E-01
.0000E+00	.4700E+00	.5560E+00	.2660E+00	.3600E+00	.1800E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.6000E-01	.1200E+00	.5360E+00	.1200E+00	.1200E+00	.5120E+00
.1200E+00	.2400E+00	.2760E+00	.3360E+00	.1200E+00	.9600E-01
.0000E+00	.2760E+00	.3600E+00	.2960E+00	.3560E+00	.5360E+00
.0000E+00	.0000E+00	.6000E-01	.6000E-01	.0000E+00	.1200E+00
.0000E+00	.1200E+00	.2160E+00	.3480E+00	.4160E+00	.4880E+00
.1800E+00	.1800E+00	.6000E-01	.4320E+00	.1200E+00	.3200E+00
.2160E+00	.1200E+00	.1200E+00	.1800E+00	.1200E+00	.2600E+00
.6000E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.6000E-01
.1200E+00	.0000E+00	.0000E+00	.0000E+00	.6000E-01	.0000E+00
.0000E+00	.6000E-01	.1800E+00	.1560E+00	.5000E+00	.3360E+00
.3720E+00	.0000E+00	.0000E+00	.6000E-01	.6000E-01	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.1800E+00	.0000E+00	.0000E+00	.6000E-01	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.5260E+00	.1800E+00	.1200E+00	.6000E-01	.2400E+00	.0000E+00

.6000E-01	.2160E+00	.4320E+00	.4160E+00	.6000E-01	.2400E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.6000E-01	.0000E+00	.1920E+00	.0000E+00	.6000E-01	.1200E+00
.1200E+00	.3120E+00	.1200E+00	.2160E+00	.0000E+00	.3720E+00
.4320E+00	.1560E+00	.0000E+00	.0000E+00	.9600E-01	.6000E-01
.0000E+00	.1560E+00	.2160E+00	.3360E+00	.0000E+00	.1800E+00
.0000E+00	.1200E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.6000E-01	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.6000E-01	.0000E+00	.3200E+00	.3560E+00	.1920E+00
.1200E+00	.1560E+00	.1800E+00	.2400E+00	.2400E+00	.1800E+00
.2160E+00	.0000E+00	.0000E+00	.2520E+00	.0000E+00	.1800E+00
.0000E+00	.2760E+00	.6000E-01	.2160E+00	.1920E+00	.2760E+00
.2400E+00	.1800E+00	.0000E+00	.0000E+00	.1800E+00	.1560E+00
.0000E+00	.0000E+00	.6000E-01	.0000E+00	.6000E-01	.2160E+00
.6000E-01	.1200E+00	.9600E-01	.2520E+00	.9600E-01	.2960E+00
.6000E-01	.0000E+00	.4300E+00	.0000E+00	.0000E+00	.0000E+00
.1200E+00	.1200E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.2400E+00	.0000E+00	.0000E+00	.0000E+00	.6000E-01	.1560E+00
.0000E+00	.0000E+00	.1560E+00	.2160E+00	.4160E+00	.3360E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.9600E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.6000E-01	.6000E-01	.6000E-01	.0000E+00
.2160E+00	.2360E+00	.1200E+00	.1200E+00	.9600E-01	.1560E+00
.0000E+00	.0000E+00	.6000E-01	.1560E+00	.1200E+00	.6000E-01
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.1200E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.6000E-01	.0000E+00	.0000E+00	.0000E+00
.3120E+00	.3880E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.6000E-01	.6000E-01	.6000E-01	.0000E+00
.0000E+00	.0000E+00	.3120E+00	.6000E-01	.1200E+00	.0000E+00
.1200E+00	.2000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.6000E-01	.9600E-01	.1800E+00	.3480E+00	.6000E-01
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.6000E-01	.3000E+00	.1800E+00	.1200E+00	.3000E+00
.2760E+00	.2160E+00	.1200E+00	.0000E+00	.6000E-01	.6000E-01
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.1200E+00	.0000E+00	.0000E+00	.6000E-01	.0000E+00
.6000E-01	.6000E-01	.9600E-01	.6000E-01	.3360E+00	.1200E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.6000E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.1200E+00
.3000E+00	.0000E+00	.6000E-01	.1560E+00	.0000E+00	.1200E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.6000E-01	.1200E+00	.3120E+00	.6000E-01	.1200E+00	.1200E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.2160E+00	.1200E+00	.0000E+00	.0000E+00	.6000E-01	.1200E+00
.0000E+00	.6000E-01	.0000E+00	.0000E+00	.0000E+00	.6000E-01
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
[illegible]880E+00	.0000E+00	.6000E-01	.0000E+00	.9600E-01	.0000E+00
.0000E+00	.6000E-01	.3460E+00	.0000E+00	.0000E+00	.6000E-01
.0000E+00	.6000E-01	.9600E-01	.2400E+00	.0000E+00	.6000E-01
.6000E-01	.1200E+00	.1800E+00	.6000E-01	.1200E+00	.9600E-01
.1560E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00

.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.1200E+00	.0000E+00	.0000E+00
.0000E+00	.6000E-01	.0000E+00	.1200E+00	.6000E-01	.0000E+00
.6000E-01	.1200E+00	.9600E-01	.0000E+00	.6000E-01	.0000E+00
.0000E+00	.0000E+00	.2160E+00	.0000E+00	.2160E+00	.1200E+00
.6000E-01	.0000E+00	.0000E+00	.0000E+00	.3700E+00	.0000E+00
.2400E+00	.0000E+00	.9600E-01	.0000E+00	.0000E+00	.0000E+00
.2160E+00	.0000E+00	.0000E+00	.0000E+00	.6000E-01	.0000E+00
.6000E-01	.0000E+00	.0000E+00	.0000E+00	.9600E-01	.0000E+00
.4200E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.1200E+00	.0000E+00	.0000E+00	.6000E-01
.0000E+00	.6000E-01	.0000E+00	.6000E-01	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.6000E-01	.0000E+00	.6000E-01	.6000E-01
.0000E+00	.0000E+00	.6000E-01	.6000E-01	.2760E+00	.1560E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.6000E-01	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.6000E-01
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.6000E-01	.0000E+00	.0000E+00	.1200E+00	.0000E+00
.0000E+00	.0000E+00	.9600E-01	.6000E-01	.9600E-01	.0000E+00
.0000E+00	.0000E+00	.9600E-01	.4440E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.9600E-01
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.6000E-01	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.2360E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.6000E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.9600E-01	.0000E+00	.1800E+00
.1200E+00	.1200E+00	.0000E+00	.0000E+00	.6000E-01	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.1560E+00	.0000E+00	.6000E-01	.6000E-01
.0000E+00	.0000E+00	.0000E+00	.6000E-01	.0000E+00	.0000E+00
.0000E+00	.9600E-01	.1200E+00	.6000E-01	.0000E+00	.6000E-01
.0000E+00	.0000E+00	.0000E+00	.6000E-01	.1920E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.9600E-01	.0000E+00	.0000E+00	.6000E-01	.6000E-01	.1200E+00
.6000E-01	.0000E+00	.0000E+00	.0000E+00	.6000E-01	.0000E+00
.6000E-01	.0000E+00	.6000E-01	.0000E+00	.0000E+00	.6000E-01
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.1200E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.6000E-01	.0000E+00	.0000E+00
.0000E+00	.6000E-01	.0000E+00	.0000E+00	.9600E-01	.0000E+00
.3000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.6000E-01	.0000E+00	.0000E+00	.0000E+00	.6000E-01	.0000E+00
.0000E+00	.0000E+00	.9600E-01	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.6000E-01	.1920E+00	.0000E+00	.6000E-01
.0000E+00	.0000E+00	.6000E-01	.6000E-01	.0000E+00	.2400E+00

EB087	EB104	EB106	BK01M	BK04A
.2026E+01	.2448E+01	.2188E+01	.3000E+00	.1888E+01
.2176E+01	.2114E+01	.1926E+01	.2960E+00	.1682E+01
.1106E+01	.1798E+01	.4580E+00	.2400E+00	.1686E+01
.1344E+01	.1918E+01	.8660E+00	.1800E+00	.1796E+01
.6760E+00	.1582E+01	.1470E+01	.2760E+00	.1460E+01
.2082E+01	.1842E+01	.1764E+01	.6320E+00	.1464E+01
.2054E+01	.1938E+01	.1242E+01	.2160E+00	.1368E+01
.1024E+01	.1432E+01	.3800E+00	.5920E+00	.1850E+01
.2208E+01	.1494E+01	.1844E+01	.5120E+00	.2160E+00

.6820E+00	.1148E+01	.7780E+00	.3360E+00	.1232E+01
.0000E+00	.3100E+00	.0000E+00	.6000E-01	.1162E+01
.8280E+00	.9660E+00	.1310E+01	.0000E+00	.5560E+00
[illegible]000E+00	.6000E-01	.1800E+00	.1984E+01	.0000E+00
[illegible]520E+00	.8840E+00	.7040E+00	.1318E+01	.9280E+00
.1326E+01	.1054E+01	.1134E+01	.3720E+00	.8700E+00
.8240E+00	.1338E+01	.6000E-01	.2600E+00	.3960E+00
.1260E+01	.6260E+00	.1080E+01	.1280E+01	.4360E+00
.1636E+01	.1198E+01	.9680E+00	.1194E+01	.0000E+00
.9860E+00	.1094E+01	.9300E+00	.5360E+00	.7640E+00
.5120E+00	.5040E+00	.1002E+01	.2000E+00	.8500E+00
.1262E+01	.8580E+00	.8600E+00	.9520E+00	.6320E+00
.9180E+00	.9660E+00	.5600E+00	.3720E+00	.3560E+00
.7120E+00	.1500E+01	.1200E+00	.1378E+01	.0000E+00
.7980E+00	.5160E+00	.9560E+00	.0000E+00	.9940E+00
.8900E+00	.7280E+00	.2960E+00	.9600E-01	.6200E+00
.0000E+00	.0000E+00	.0000E+00	.1814E+01	.0000E+00
.5120E+00	.8160E+00	.4920E+00	.4520E+00	.8760E+00
.9600E-01	.5760E+00	.2400E+00	.1154E+01	.7480E+00
.4080E+00	.8780E+00	.1560E+00	.0000E+00	.3120E+00
.5400E+00	.6280E+00	.8700E+00	.9140E+00	.7760E+00
.8840E+00	.9540E+00	.4960E+00	.6640E+00	.7060E+00
.3200E+00	.7660E+00	.7300E+00	.0000E+00	.9480E+00
.1132E+01	.4720E+00	.7220E+00	.6900E+00	.6120E+00
.2160E+00	.5920E+00	.3360E+00	.6000E-01	.1560E+00
.1102E+01	.5980E+00	.6480E+00	.7000E+00	.5600E+00
.1122E+01	.8940E+00	.2000E+00	.0000E+00	.2600E+00
.2400E+00	.7400E+00	.6000E-01	.1114E+01	.8020E+00
.1216E+01	.6120E+00	.9360E+00	.8720E+00	.1560E+00
[illegible]220E+00	.3720E+00	.1034E+01	.6580E+00	.3480E+00
.6000E-01	.5600E+00	.4280E+00	.0000E+00	.7660E+00
.4800E+00	.8820E+00	.2400E+00	.1416E+01	.0000E+00
.1200E+00	.5400E+00	.4460E+00	.0000E+00	.1036E+01
.0000E+00	.0000E+00	.0000E+00	.1554E+01	.0000E+00
.6000E-01	.1560E+00	.0000E+00	.1520E+01	.9600E-01
.0000E+00	.5560E+00	.1200E+00	.1118E+01	.4800E+00
.1094E+01	.1022E+01	.3360E+00	.9140E+00	.0000E+00
.0000E+00	.2960E+00	.6000E-01	.0000E+00	.9100E+00
.8020E+00	.6200E+00	.1800E+00	.0000E+00	.6000E-01
.1024E+01	.4680E+00	.6040E+00	.1560E+00	.1560E+00
.4820E+00	.6960E+00	.3360E+00	.9100E+00	.7780E+00
.9940E+00	.7360E+00	.1560E+00	.3360E+00	.6000E-01
.6000E-01	.9600E-01	.0000E+00	.0000E+00	.1132E+01
.0000E+00	.3560E+00	.1400E+00	.0000E+00	.0000E+00
.2400E+00	.0000E+00	.6020E+00	.9280E+00	.2400E+00
.8040E+00	.5520E+00	.5560E+00	.5120E+00	.6000E-01
.5560E+00	.5620E+00	.9600E-01	.0000E+00	.6000E-01
.8560E+00	.4680E+00	.8160E+00	.6160E+00	.0000E+00
.1200E+00	.6000E-01	.6820E+00	.1200E+00	.0000E+00
.7180E+00	.5900E+00	.2360E+00	.0000E+00	.3920E+00
.4520E+00	.7800E+00	.6000E-01	.0000E+00	.4960E+00
.5280E+00	.8020E+00	.5600E+00	.3000E+00	.4000E+00
.4200E+00	.2160E+00	.6000E-01	.9600E-01	.7740E+00
.9860E+00	.3100E+00	.0000E+00	.2400E+00	.1200E+00
.7600E+00	.6460E+00	.0000E+00	.0000E+00	.2760E+00
[illegible]000E-01	.4160E+00	.6000E-01	.2880E+00	.6160E+00
.6000E-01	.9600E-01	.6000E-01	.3800E+00	.5720E+00
.1200E+00	.0000E+00	.1920E+00	.3560E+00	.6320E+00
.2160E+00	.1200E+00	.5600E+00	.1800E+00	.5500E+00
.3360E+00	.7260E+00	.4080E+00	.1560E+00	.1800E+00

Q

.2760E+00	.5200E+00	.1200E+00	.9600E-01	.6000E-01
.3000E+00	.3720E+00	.2760E+00	.2400E+00	.0000E+00
.1800E+00	.2160E+00	.6780E+00	.0000E+00	.0000E+00
.2160E+00	.6000E-01	.6000E-01	.6000E-01	.8700E+00
.2960E+00	.7800E+00	.1800E+00	.0000E+00	.6000E-01
.9600E-01	.4560E+00	.1200E+00	.1800E+00	.4660E+00
.4760E+00	.3360E+00	.1200E+00	.6000E-01	.2400E+00
.1200E+00	.6000E-01	.0000E+00	.0000E+00	.3620E+00
.8500E+00	.3360E+00	.3500E+00	.9600E-01	.0000E+00
.4080E+00	.3360E+00	.4060E+00	.0000E+00	.1920E+00
.0000E+00	.6000E-01	.0000E+00	.8380E+00	.4560E+00
.5320E+00	.3720E+00	.3960E+00	.2160E+00	.4760E+00
.1560E+00	.4920E+00	.1200E+00	.0000E+00	.2960E+00
.9320E+00	.7180E+00	.1200E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.6000E-01	.9680E+00	.2520E+00
.6780E+00	.6400E+00	.3120E+00	.0000E+00	.0000E+00
.1200E+00	.9600E-01	.0000E+00	.9900E+00	.6000E-01
.8120E+00	.3800E+00	.2160E+00	.0000E+00	.9600E-01
.9600E-01	.1200E+00	.2160E+00	.0000E+00	.0000E+00
.1200E+00	.1920E+00	.1200E+00	.4320E+00	.2300E+00
.1800E+00	.4160E+00	.1200E+00	.0000E+00	.1920E+00
.0000E+00	.0000E+00	.0000E+00	.1058E+01	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.5760E+00	.2760E+00
.2160E+00	.4760E+00	.3800E+00	.1200E+00	.3960E+00
.0000E+00	.1400E+00	.0000E+00	.0000E+00	.4920E+00
.4820E+00	.5280E+00	.3560E+00	.6400E+00	.6000E-01
.6000E-01	.2400E+00	.0000E+00	.3960E+00	.4320E+00
.4080E+00	.3360E+00	.1560E+00	.9600E-01	.1200E+00
.5860E+00	.5660E+00	.1200E+00	.0000E+00	.6000E-01
.6360E+00	.2760E+00	.6000E-01	.7340E+00	.0000E+00
.8100E+00	.4460E+00	.4320E+00	.6000E-01	.0000E+00
.6000E-01	.3120E+00	.0000E+00	.0000E+00	.6160E+00
.5120E+00	.1200E+00	.3360E+00	.5880E+00	.1200E+00
.0000E+00	.6000E-01	.0000E+00	.8600E+00	.0000E+00
.6000E-01	.1200E+00	.0000E+00	.7520E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.8120E+00	.0000E+00
.0000E+00	.1560E+00	.3000E+00	.6000E-01	.2400E+00
.6000E-01	.1560E+00	.0000E+00	.1200E+00	.4320E+00
.2160E+00	.0000E+00	.0000E+00	.9560E+00	.0000E+00
.6000E-01	.0000E+00	.6000E-01	.6480E+00	.0000E+00
.3200E+00	.5960E+00	.1560E+00	.2400E+00	.0000E+00
.3120E+00	.3400E+00	.1200E+00	.0000E+00	.0000E+00
.5160E+00	.3720E+00	.6000E-01	.0000E+00	.0000E+00
.1920E+00	.2600E+00	.0000E+00	.2960E+00	.2760E+00
.1200E+00	.4660E+00	.9600E-01	.5440E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.7000E+00	.5300E+00
.3720E+00	.2800E+00	.0000E+00	.0000E+00	.0000E+00
.2760E+00	.0000E+00	.6000E-01	.2160E+00	.2400E+00
.5760E+00	.1200E+00	.1200E+00	.2160E+00	.0000E+00
.1200E+00	.1560E+00	.2160E+00	.0000E+00	.3360E+00
.9600E-01	.2400E+00	.1800E+00	.6000E-01	.2000E+00
.1200E+00	.2520E+00	.0000E+00	.4460E+00	.2000E+00
.1200E+00	.3720E+00	.1200E+00	.0000E+00	.0000E+00
.6000E-01	.9600E-01	.0000E+00	.1200E+00	.3100E+00
.3360E+00	.3480E+00	.6000E-01	.5000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.8500E+00	.0000E+00
.1200E+00	.6000E-01	.6000E-01	.5800E+00	.0000E+00
.0000E+00	.6000E-01	.0000E+00	.0000E+00	.3120E+00
.0000E+00	.9600E-01	.0000E+00	.7820E+00	.0000E+00
.0000E+00	.0000E+00	.6000E-01	.7920E+00	.0000E+00

.2760E+00	.1560E+00	.0000E+00	.5880E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.6320E+00	.4080E+00
.1200E+00	.0000E+00	.1200E+00	.9600E-01	.2160E+00
.1800E+00	.1200E+00	.0000E+00	.4900E+00	.6000E-01
.2000E+00	.0000E+00	.0000E+00	.6780E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.6080E+00	.6000E-01
.0000E+00	.0000E+00	.0000E+00	.6420E+00	.0000E+00
.6000E-01	.3000E+00	.0000E+00	.5760E+00	.1200E+00
.3600E+00	.1800E+00	.3120E+00	.3360E+00	.0000E+00
.2000E+00	.6000E-01	.0000E+00	.0000E+00	.6000E-01
.6360E+00	.3800E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.9600E-01	.0000E+00	.6220E+00	.2160E+00
.0000E+00	.0000E+00	.0000E+00	.4520E+00	.2160E+00
.1200E+00	.0000E+00	.4700E+00	.1800E+00	.0000E+00
.1200E+00	.2960E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.7100E+00	.0000E+00
.6000E-01	.1560E+00	.6000E-01	.0000E+00	.1200E+00
.2760E+00	.6000E-01	.1800E+00	.0000E+00	.6000E-01
.0000E+00	.0000E+00	.0000E+00	.7120E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.7060E+00	.0000E+00
.6000E-01	.4800E+00	.0000E+00	.2400E+00	.2160E+00
.1200E+00	.1200E+00	.0000E+00	.0000E+00	.0000E+00
.2520E+00	.4460E+00	.6000E-01	.2160E+00	.6000E-01
.1200E+00	.0000E+00	.1560E+00	.5120E+00	.0000E+00
.0000E+00	.6000E-01	.3360E+00	.0000E+00	.6000E-01
.1200E+00	.6000E-01	.0000E+00	.6760E+00	.0000E+00
.1560E+00	.1200E+00	.0000E+00	.1800E+00	.0000E+00
.6000E-01	.0000E+00	.0000E+00	.5880E+00	.6000E-01
.0000E+00	.0000E+00	.0000E+00	.5980E+00	.0000E+00
.2760E+00	.1200E+00	.1400E+00	.0000E+00	.6000E-01
.3000E+00	.6000E-01	.1200E+00	.4160E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.1200E+00	.6520E+00
.0000E+00	.0000E+00	.3200E+00	.6000E-01	.0000E+00
.0000E+00	.0000E+00	.6000E-01	.1800E+00	.6000E-01
.0000E+00	.0000E+00	.0000E+00	.9600E-01	.3920E+00
.0000E+00	.6000E-01	.1920E+00	.6000E-01	.1560E+00
.2760E+00	.1200E+00	.3560E+00	.6000E-01	.0000E+00
.4560E+00	.9600E-01	.1200E+00	.1800E+00	.9600E-01
.1200E+00	.9600E-01	.0000E+00	.4320E+00	.1560E+00
.6000E-01	.1200E+00	.6000E-01	.3860E+00	.0000E+00
.1560E+00	.2160E+00	.2160E+00	.0000E+00	.1200E+00
.6000E-01	.2600E+00	.0000E+00	.0000E+00	.6000E-01
.0000E+00	.6000E-01	.0000E+00	.0000E+00	.0000E+00
.2760E+00	.6000E-01	.2000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.3480E+00	.9600E-01
.2800E+00	.6000E-01	.2160E+00	.0000E+00	.0000E+00
.9600E-01	.0000E+00	.9600E-01	.0000E+00	.0000E+00
.2400E+00	.6000E-01	.2600E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.6000E-01	.4760E+00	.0000E+00
.1400E+00	.1560E+00	.6000E-01	.1560E+00	.0000E+00
.6000E-01	.6000E-01	.0000E+00	.9600E-01	.0000E+00
.2760E+00	.2160E+00	.0000E+00	.6000E-01	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.4060E+00	.0000E+00
.6000E-01	.0000E+00	.0000E+00	.4160E+00	.0000E+00
.6000E-01	.2520E+00	.0000E+00	.1200E+00	.0000E+00
.6000E-01	.1200E+00	.6000E-01	.1200E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.6000E-01
.3720E+00	.0000E+00	.0000E+00	.1200E+00	.0000E+00
.6000E-01	.1560E+00	.0000E+00	.3560E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.2960E+00	.0000E+00

.0000E+00	.0000E+00	.0000E+00	.4720E+00	.0000E+00
.0000E+00	.6000E-01	.0000E+00	.2760E+00	.0000E+00
.1200E+00	.2520E+00	.0000E+00	.2160E+00	.0000E+00
.0000E+00	.6000E-01	.0000E+00	.2000E+00	.0000E+00
.1800E+00	.6000E-01	.9600E-01	.0000E+00	.0000E+00
.6000E-01	.9600E-01	.0000E+00	.3360E+00	.0000E+00
.6000E-01	.0000E+00	.2360E+00	.0000E+00	.1400E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.3000E+00
.0000E+00	.1560E+00	.0000E+00	.2760E+00	.0000E+00
.1200E+00	.1800E+00	.0000E+00	.0000E+00	.0000E+00
.9600E-01	.0000E+00	.6000E-01	.1800E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.3960E+00	.0000E+00
.0000E+00	.9600E-01	.6000E-01	.6000E-01	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.3200E+00	.0000E+00
.9600E-01	.0000E+00	.1560E+00	.9600E-01	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.3100E+00	.0000E+00
.6000E-01	.9600E-01	.9600E-01	.9600E-01	.0000E+00
.1200E+00	.0000E+00	.0000E+00	.2160E+00	.9600E-01
.6000E-01	.6000E-01	.6000E-01	.1560E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.3500E+00	.0000E+00
.1560E+00	.9600E-01	.0000E+00	.0000E+00	.1200E+00
.1800E+00	.1200E+00	.0000E+00	.9600E-01	.0000E+00
.0000E+00	.0000E+00	.0000E+00	.6000E-01	.1200E+00
.6000E-01	.6000E-01	.0000E+00	.0000E+00	.0000E+00

SIGTREE Options:

(1) Coefficient = Bray-Curtis Coefficient
(2) Linkage = UPGMA
(3) No. of simulations = 500

Similarity Matrix

	EB049	EB060	EB067	EB077	EB080	EB085	EB087
EB049	1.00000						
EB060	.66668	1.00000					
EB067	.58671	.76275	1.00000				
EB077	.58042	.74042	.77428	1.00000			
EB080	.61551	.73802	.77305	.74645	1.00000		
EB085	.60227	.77233	.79595	.83707	.77276	1.00000	
EB087	.67375	.59834	.54607	.58989	.56580	.57611	1.00000
EB104	.63349	.70701	.67232	.69755	.69278	.69367	.74310
EB106	.77047	.63749	.58337	.56905	.58097	.58440	.66814
BK01M	.32495	.30020	.33400	.34450	.30482	.32562	.39706
BK04A	.54125	.70324	.75528	.73527	.69433	.72848	.50060

	EB104	EB106	BK01M	BK04A
EB104	1.00000			
EB106	.63640	1.00000		
BK01M	.40915	.36907	1.00000	
BK04A	.61295	.55794	.34928	1.00000

```
                                                     *****************EB049
                                             *********
                                             *       *****************EB106
                                          ****
                                          *  *      ******************EB087
                                          *  ********
                                          *         ******************EB104
                                          *
                        *******************         ******************EB060
                        *                 *         *
                        *                 *       *** ****************EB067
                        *                 *       * ***
                        *                 *       * ***   ************EB077
                        *                 *       * *******
                        *                 *********  *    ************EB085
                        *                         *  *
                        *                         *  *****************EB080
                        *                         *
                        *                         ********************BK04A
                        *
                        **********************************************BK01M

|-------------|-------------|-------------|-------------|-------------|
0            .2            .4            .6            .8             1
```

SIMILARITY
Scale Factor = .1E+01

Linkage	Clusters Linked		Similarity	Prob
1	EB077	EB085	.83707	.08000
2	EB067	EB077	.78511	.00400
3	EB049	EB106	.77047	.01000
4	EB067	EB080	.76409	.00400
5	EB060	EB067	.75338	.00000
6	EB087	EB104	.74310	.00800
7	EB060	BK04A	.72332	.00000
8	EB049	EB087	.65295	.00000
9	EB049	EB060	.60663	.00000
10	EB049	BK01M	.34586	.00000

CORRELATION RESULTS

- Sediment Chemistry/Conventionals vs. Laboratory Bioassay: Benthic Endpoints
- Sediment Chemistry vs. Clam Tissue Chemistry

Sediment Chemistry/Conventionals vs. Laboratory Bioassay: Benthic Endpoints

Pearson Correlation Results - Sediment LPAH Concentrations vs. Bioassay and Benthic Endpoints

Sediment chemical data (log-transformed):
LACENAP = Acenaphthene
LACNPTYL = Acenaphthylene
LANTHRA = Anthracene
LFLUOREN = Fluorene
LNAPTH = Naphthalene
LPHENAN = Phenanthrene
LMNAPTH2 = 2-Methylnaphthalene
LTLPAH = Total LPAHs

Sediment conventional data (decimal fractions) :
DTFINE = Fines (silt+clay)
DTSAND = Sand
DTOC = Total organic carbon

Bioassay Endpoints (arcsin-square root transformed):
TAMORT = Amphipod mortality
TEEFFM = Echinoderm effective mortality

Benthic Endpoints [except for TRICH, all log(x+1)transformed]:
TCRSTAB = Crustacea abundance
TMOLLAB = Mollusc abundance
TPOLYAB = Polychaete abundance
TMISCAB = Miscellaneous taxa abundance
TTABUND = Total abundance
TRICH = Total richness

Pearson Correlation Matrix (r values)

	LACENAP	LACNPTYL	LANTHRA	LFLUOREN	LNAPTH
LACENAP	1.000				
LACNPTYL	0.781	1.000			
LANTHRA	0.887	0.761	1.000		
LFLUOREN	0.993	0.766	0.927	1.000	
LNAPTH	0.989	0.783	0.891	0.982	1.000
LPHENAN	0.978	0.746	0.936	0.994	0.967
LMNAPTH2	0.983	0.748	0.894	0.982	0.996
LTLPAH	0.987	0.778	0.941	0.997	0.985
DTFINE	-0.653	-0.324	-0.351	-0.591	-0.681
DTSAND	0.549	0.281	0.208	0.472	0.573
DTOC	0.406	0.318	0.501	0.454	0.439
TAMORT	0.536	0.530	0.610	0.539	0.597
TEEFFM	0.861	0.612	0.896	0.898	0.847
TCRSTAB	0.578	0.245	0.383	0.532	0.643
TMOLLAB	-0.003	-0.167	-0.307	-0.071	0.043
TPOLYAB	0.502	0.311	0.756	0.567	0.520
TMISCAB	-0.400	-0.165	-0.239	-0.384	-0.417
TTABUND	0.508	0.199	0.342	0.473	0.587
TRICH	0.517	0.219	0.764	0.592	0.533

	LPHENAN	LMNAPTH2	LTLPAH	DTFINE	DTSAND
LPHENAN	1.000				
LMNAPTH2	0.975	1.000			
LTLPAH	0.995	0.987	1.000		
DTFINE	-0.530	-0.674	-0.573	1.000	
DTSAND	0.400	0.557	0.449	-0.982	1.000
DTOC	0.530	0.480	0.496	0.099	-0.238
TAMORT	0.502	0.589	0.557	-0.536	0.491
TEEFFM	0.907	0.853	0.896	-0.414	0.266
TCRSTAB	0.474	0.637	0.531	-0.923	0.884
TMOLLAB	-0.098	0.028	-0.078	-0.445	0.501
TPOLYAB	0.577	0.543	0.587	-0.138	-0.001
TMISCAB	-0.407	-0.468	-0.397	0.447	-0.394
TTABUND	0.440	0.586	0.483	-0.773	0.729
TRICH	0.614	0.560	0.609	-0.122	-0.046

	DTOC	TAMORT	TEEFFM	TCRSTAB	TMOLLAB
DTOC	1.000				
TAMORT	-0.124	1.000			
TEEFFM	0.526	0.339	1.000		
TCRSTAB	-0.057	0.644	0.369	1.000	

TMOLLAB	-0.102	-0.068	-0.156	0.466	1.000
TPOLYAB	0.292	0.590	0.554	0.303	-0.589
TMISCAB	-0.400	-0.199	-0.162	-0.334	0.102
TTABUND	0.073	0.585	0.318	0.904	0.676
TRICH	0.445	0.401	0.696	0.296	-0.456

	TPOLYAB	TMISCAB	TTABUND	TRICH
TPOLYAB	1.000			
TMISCAB	-0.274	1.000		
TTABUND	0.164	-0.195	1.000	
TRICH	0.932	-0.164	0.212	1.000

>

>

Pearson Correlation Results - Sediment HPAH Concentrations vs. Bioassay and Benthic Endpoints

Sediment chemical data (log-transformed):
LTBNZFLUR = Total benzofluoranthenes
LBNZAANT = Benz(a)anthracene
LBNZAPYR = Benzo(a)pyrene
LBGHIP = Benzo(g,h,i)perylene
LCHRYS = Chrysene
LDBNZAHA = Dibenzo(a,h)anthracene
LFLURANT = Fluoranthene
LINDENO = Indeno(1,2,3-cd)pyrene
LPYRENE = Pyrene
LTHPAH = Total HPAHs

Sediment conventional data (decimal fractions) :
DTFINE = Fines (silt+clay)
DTSAND = Sand
DTOC = Total organic carbon

Bioassay Endpoints (arcsin-square root transformed):
TAMORT = Amphipod mortality
TEEFFM = Echinoderm effective mortality

Benthic Endpoints [except for TRICH, all log(x+1)transformed]:
TCRSTAB = Crustacea abundance
TMOLLAB = Mollusc abundance
TPOLYAB = Polychaete abundance
TMISCAB = Miscellaneous taxa abundance
TTABUND = Total abundance
TRICH = Total richness

Pearson Correlation Matrix (r values)

	LTBNZFLU	LBNZAANT	LBNZAPYR	LBGHIP	LCHRYS
LTBNZFLU	1.000				
LBNZAANT	0.918	1.000			
LBNZAPYR	0.983	0.835	1.000		
LBGHIP	0.869	0.635	0.937	1.000	
LCHRYS	0.950	0.965	0.893	0.711	1.000
LDBNZAHA	0.891	0.674	0.952	0.994	0.755
LFLURANT	0.475	0.770	0.310	0.036	0.648
LINDENO	0.874	0.627	0.945	0.995	0.714
LPYRENE	0.488	0.770	0.338	0.084	0.651
LTHPAH	0.721	0.927	0.594	0.347	0.844
DTFINE	0.491	0.208	0.623	0.798	0.295
DTSAND	-0.583	-0.339	-0.697	-0.831	-0.400
DTOC	0.322	0.479	0.260	0.199	0.334
TAMORT	0.286	0.339	0.194	-0.006	0.349
TEEFFM	0.377	0.710	0.211	-0.069	0.561
TCRSTAB	-0.366	-0.128	-0.482	-0.657	-0.160
TMOLLAB	-0.708	-0.586	-0.729	-0.612	-0.605
TPOLYAB	0.595	0.667	0.523	0.243	0.660
TMISCAB	0.273	0.163	0.324	0.414	0.309
TTABUND	-0.333	-0.118	-0.435	-0.549	-0.160
TRICH	0.554	0.706	0.469	0.196	0.664

	LDBNZAHA	LFLURANT	LINDENO	LPYRENE	LTHPAH
LDBNZAHA	1.000				
LFLURANT	0.083	1.000			
LINDENO	0.992	0.013	1.000		
LPYRENE	0.139	0.974	0.058	1.000	
LTHPAH	0.397	0.936	0.328	0.952	1.000
DTFINE	0.775	-0.385	0.787	-0.277	-0.059
DTSAND	-0.819	0.245	-0.821	0.124	-0.094
DTOC	0.229	0.587	0.152	0.733	0.648
TAMORT	0.003	0.451	0.034	0.333	0.352
TEEFFM	-0.019	0.960	-0.090	0.925	0.881
TCRSTAB	-0.618	0.372	-0.636	0.304	0.117
TMOLLAB	-0.643	-0.174	-0.659	-0.181	-0.372
TPOLYAB	0.311	0.582	0.301	0.598	0.667
TMISCAB	0.406	-0.193	0.393	-0.228	-0.033
TTABUND	-0.535	0.344	-0.553	0.309	0.133
TRICH	0.275	0.667	0.233	0.712	0.758

	DTFINE	DTSAND	DTOC	TAMORT	TEEFFM
DTFINE	1.000				
DTSAND	-0.982	1.000			
DTOC	0.099	-0.238	1.000		
TAMORT	-0.536	0.491	-0.124	1.000	
TEEFFM	-0.414	0.266	0.526	0.339	1.000
TCRSTAB	-0.923	0.884	-0.057	0.644	0.369
TMOLLAB	-0.445	0.501	-0.102	-0.068	-0.156
TPOLYAB	-0.138	-0.001	0.292	0.590	0.554
TMISCAB	0.447	-0.394	-0.400	-0.199	-0.162
TTABUND	-0.773	0.729	0.073	0.585	0.318
TRICH	-0.122	-0.046	0.445	0.401	0.696

	TCRSTAB	TMOLLAB	TPOLYAB	TMISCAB	TTABUND
TCRSTAB	1.000				
TMOLLAB	0.466	1.000			
TPOLYAB	0.303	-0.589	1.000		
TMISCAB	-0.334	0.102	-0.274	1.000	
TTABUND	0.904	0.676	0.164	-0.195	1.000
TRICH	0.296	-0.456	0.932	-0.164	0.212

	TRICH
TRICH	1.000

>

Pearson Correlation Results - Sediment Hg, PCB, TCDD Concentrations vs. Bioassay and Benthic Endpoints

Sediment chemical data (log-transformed):
LHG = Mercury
LTCDDF = 2,3,7,8-TCDD equivalents
LTPCB = Total PCBs

Sediment conventional data (decimal fractions) :
DTFINE = Fines (silt+clay)
DTSAND = Sand
DTOC = Total organic carbon

Bioassay Endpoints (arcsin-square root transformed):
TAMORT = Amphipod mortality
TEEFFM = Echinoderm effective mortality

Benthic Endpoints [except for TRICH, all log(x+1)transformed]:
TCRSTAB = Crustacea abundance
TMOLLAB = Mollusc abundance
TPOLYAB = Polychaete abundance
TMISCAB = Miscellaneous taxa abundance
TTABUND = Total abundance
TRICH = Total richness

Pearson Correlation Matrix (r values)

	LHG	LTCDDF	LTPCB	DTFINE	DTSAND
LHG	1.000				
LTCDDF	-0.435	1.000			
LTPCB	-0.114	0.768	1.000		
DTFINE	0.113	0.457	0.733	1.000	
DTSAND	-0.153	-0.535	-0.754	-0.982	1.000
DTOC	0.753	-0.061	-0.071	0.099	-0.238
TAMORT	-0.065	0.194	-0.005	-0.536	0.491
TEEFFM	0.224	0.018	-0.224	-0.414	0.266
TCRSTAB	-0.179	-0.258	-0.672	-0.923	0.884
TMOLLAB	-0.123	-0.525	-0.739	-0.445	0.501
TPOLYAB	-0.001	0.532	0.329	-0.138	-0.001
TMISCAB	-0.426	0.293	0.162	0.447	-0.394
TTABUND	-0.106	-0.222	-0.636	-0.773	0.729
TRICH	-0.024	0.528	0.199	-0.122	-0.046

	DTOC	TAMORT	TEEFFM	TCRSTAB	TMOLLAB
DTOC	1.000				
TAMORT	-0.124	1.000			
TEEFFM	0.526	0.339	1.000		
TCRSTAB	-0.057	0.644	0.369	1.000	
TMOLLAB	-0.102	-0.068	-0.156	0.466	1.000
TPOLYAB	0.292	0.590	0.554	0.303	-0.589
TMISCAB	-0.400	-0.199	-0.162	-0.334	0.102
TTABUND	0.073	0.585	0.318	0.904	0.676
TRICH	0.445	0.401	0.696	0.296	-0.456

	TPOLYAB	TMISCAB	TTABUND	TRICH
TPOLYAB	1.000			
TMISCAB	-0.274	1.000		
TTABUND	0.164	-0.195	1.000	
TRICH	0.932	-0.164	0.212	1.000

>

Sediment Chemistry vs. Clam Tissue Chemistry

Pearson Correlation Restults - Sediment and Clam Tissue LPAH Concentrations

Sediment chemical data (log-transformed) represented by "LS" prefix
Clam tissue chemical data (log-transformed) represented by "LC" prefix

MNAPTH2 = 2-Methylnaphthalene
NAPTH = Naphthalene
ACNPTYL = Acenaphthylene
ACENAP = Acenaphthene
FLUOREN = Fluorene
ANTHRA = Anthracene
PHENAN = Phenanthrene
TLPAH = Total LPAHs

Pearson Correlation Matrix (r values)

	LSMNAPTH2	LSNAPTH	LSACNPTYL	LSACENAP	LSFLUOREN
LSMNAPTH2	1.000				
LSNAPTH	0.993	1.000			
LSACNPTYL	0.865	0.908	1.000		
LSACENAP	0.976	0.962	0.843	1.000	
LSFLUOREN	0.975	0.958	0.838	0.997	1.000
LSANTHRA	0.932	0.914	0.815	0.946	0.965
LSPHENAN	0.961	0.931	0.774	0.981	0.988
LSTLPAH	0.984	0.966	0.831	0.990	0.994
LCMNAPTH2	-0.280	-0.291	-0.291	-0.288	-0.229
LCNAPTH	-0.649	-0.606	-0.438	-0.613	-0.658
LCACNPTYL	-0.583	-0.612	-0.700	-0.684	-0.665
LCACENAP	-0.548	-0.544	-0.521	-0.566	-0.589
LCFLUOREN	-0.051	-0.063	-0.290	-0.048	-0.076
LCANTHRA	0.463	0.418	0.202	0.533	0.560
LCPHENAN	0.627	0.604	0.408	0.643	0.674
LCTLPAH	0.696	0.685	0.536	0.719	0.745

	LSANTHRA	LSPHENAN	LSTLPAH	LCMNAPTH2	LCNAPTH
LSANTHRA	1.000				
LSPHENAN	0.964	1.000			
LSTLPAH	0.969	0.993	1.000		
LCMNAPTH2	-0.051	-0.191	-0.221	1.000	
LCNAPTH	-0.702	-0.700	-0.669	-0.376	1.000
LCACNPTYL	-0.640	-0.590	-0.624	0.447	-0.116
LCACENAP	-0.690	-0.591	-0.601	-0.299	0.457
LCFLUOREN	-0.193	-0.041	-0.064	-0.312	0.213
LCANTHRA	0.626	0.599	0.560	0.232	-0.316
LCPHENAN	0.738	0.691	0.679	0.184	-0.455
LCTLPAH	0.791	0.743	0.741	0.115	-0.462

	LCACNPTYL	LCACENAP	LCFLUOREN	LCANTHRA	LCPHENAN
LCACNPTYL	1.000				
LCACENAP	0.419	1.000			
LCFLUOREN	0.042	0.540	1.000		
LCANTHRA	-0.396	-0.700	0.025	1.000	
LCPHENAN	-0.413	-0.674	0.029	0.931	1.000
LCTLPAH	-0.515	-0.742	-0.062	0.903	0.981

	LCTLPAH
LCTLPAH	1.000

>

Pearson Correlation Results - Sediment and Clam Tissue HPAH Concentrations

Sediment chemical data (log-transformed) represented by "LS" prefix
Clam tissue chemical data (log-transformed) represented by "LC" prefix

FLURANT = Fluoranthene
PYRENE = Pyrene
BNZAANT = Benz(a)anthracene
CHRYS = Chrysene
TBNZFLU = Total benzofluoranthenes
BNZAPYR = Benzo(a)pyrene
INDENO = Indeno(1,2,3-cd)pyrene
DBNZAHA = Dibenzo(a,h)anthracene
BGHIP = Benzo(g,h,i)perylene
THPAH = Total HPAHs

Pearson Correlation Matrix (r values)

	LSFLURANT	LSPYRENE	LSBNZAANT	LSCHRYS	LSTBNZFLU
LSFLURANT	1.000				
LSPYRENE	0.988	1.000			
LSBNZAANT	0.899	0.906	1.000		
LSCHRYS	0.864	0.873	0.983	1.000	
LSTBNZFLU	0.813	0.828	0.962	0.986	1.000
LSBNZAPYR	0.734	0.757	0.948	0.961	0.978
LSINDENO	0.608	0.640	0.874	0.908	0.948
LSDBNZAHA	0.661	0.695	0.900	0.932	0.966
LSBGHIP	0.593	0.626	0.865	0.894	0.933
LSTHPAH	0.966	0.976	0.973	0.956	0.925
LCFLURANT	0.685	0.691	0.802	0.815	0.744
LCPYRENE	0.867	0.891	0.919	0.900	0.873
LCBNZAANT	0.566	0.518	0.580	0.588	0.462
LCCHRYS	0.816	0.801	0.866	0.897	0.834
LCTBNZFLU	0.813	0.817	0.905	0.937	0.944
LCBNZAPYR	0.818	0.822	0.912	0.944	0.946
LCINDENO	0.479	0.478	0.613	0.573	0.526
LCBNZAHA	-0.533	-0.575	-0.581	-0.615	-0.688
LCBGHIP	0.492	0.492	0.635	0.587	0.538
LCTHPAH	0.856	0.864	0.924	0.940	0.914

	LSBNZAPYR	LSINDENO	LSDBNZAHA	LSBGHIP	LSTHPAH
LSBNZAPYR	1.000				
LSINDENO	0.975	1.000			
LSDBNZAHA	0.982	0.995	1.000		
LSBGHIP	0.964	0.996	0.990	1.000	
LSTHPAH	0.875	0.781	0.823	0.767	1.000
LCFLURANT	0.736	0.691	0.726	0.692	0.760
LCPYRENE	0.845	0.775	0.824	0.768	0.927
LCBNZAANT	0.447	0.362	0.391	0.363	0.549
LCCHRYS	0.791	0.714	0.758	0.695	0.860
LCTBNZFLU	0.905	0.855	0.892	0.826	0.896
LCBNZAPYR	0.909	0.856	0.893	0.828	0.901
LCINDENO	0.626	0.527	0.549	0.510	0.535
LCBNZAHA	-0.645	-0.613	-0.645	-0.580	-0.627
LCBGHIP	0.645	0.541	0.559	0.525	0.552
LCTHPAH	0.873	0.811	0.856	0.793	0.923

	LCFLURANT	LCPYRENE	LCBNZAANT	LCCHRYS	LCTBNZFLU
LCFLURANT	1.000				
LCPYRENE	0.859	1.000			
LCBNZAANT	0.854	0.574	1.000		
LCCHRYS	0.929	0.881	0.823	1.000	
LCTBNZFLU	0.767	0.909	0.501	0.894	1.000
LCBNZAPYR	0.784	0.914	0.525	0.905	0.999
LCINDENO	0.622	0.631	0.565	0.638	0.619
LCBNZAHA	-0.223	-0.572	0.130	-0.432	-0.713
LCBGHIP	0.617	0.634	0.562	0.632	0.609
LCTHPAH	0.889	0.969	0.644	0.953	0.966

	LCBNZAPYR	LCINDENO	LCBNZAHA	LCBGHIP	LCTHPAH
LCBNZAPYR	1.000				
LCINDENO	0.633	1.000			
LCBNZAHA	-0.695	-0.208	1.000		
LCBGHIP	0.623	0.995	-0.221	1.000	
LCTHPAH	0.971	0.634	-0.593	0.627	1.000

Number of observations: 11

>

Pearson Correlation Results - Sediment and Clam Tissue PCB and TCDD Concentrations

Sediment chemical data (log-transformed) represented by "LS" prefix
Clam tissue chemical data (log-transformed) represented by "LC" prefix

TPCB = Total PCBs
TCDDF = 2,3,7,8-TCDD (equivalents)

Pearson Correlation Matrix (r values)

	LSTPCB	LSTCDDF	LCTPCB	LCTCDDF
LSTPCB	1.000			
LSTCDDF	0.772	1.000		
LCTPCB	0.466	0.362	1.000	
LCTCDDF	0.673	0.954	0.290	1.000

Number of observations: 11

>

ATTACHMENT K.6

BIOASSAY DATA

Amphipod Acute Bioassay

Sample	Rep.	Visible D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	Mean Emerg	Sample Mean Emerg	Emerg St Dev	Alive	Dead	Reburial	% Mortality	Sample % Mortality	Mortality St Dev	P-Value
Control	A201	0	0	0	0	0	0	0	0	0	0	0.0			18	0	18	10.0			
	A202	0	0	0	1	0	0	0	0	0	0	0.1			18	0	15	10.0			
	A203	0	0	1	0	0	0	0	0	0	0	0.1			16	1	12	20.0			
	A204	0	0	0	0	0	0	0	0	0	0	0.0			20	0	17	0.0			
	A205	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.05	19	1	15	5.0	9.0%	6.63	
96382526	A206	0	1	0	0	1	1	1	0	2	0	0.6			10	2	7	50.0			
	A207	0	0	0	0	3	1	0	1	0	0	0.5			13	0	9	35.0			
	A208	0	0	0	0	0	0	0	0	0	0	0.0			13	0	11	35.0			
	A209	0	0	1	0	0	0	0	0	0	0	0.1			18	0	16	10.0			
	A210	0	0	0	0	0	0	0	0	0	0	0.0	0.2	0.26	18	2	13	10.0	28.0%	15.68	0.298
96382529	A211	0	0	0	0	0	0	0	0	0	0	0.0			9	0	9	55.0			
	A212	0	0	0	2	2	0	0	0	0	0	0.4			7	0	5	65.0			
	A213	1	0	0	0	0	0	0	0	0	0	0.1			3	1	2	85.0			
	A214	0	0	0	0	0	0	0	0	0	0	0.0			10	1	7	50.0			
	A215	1	0	0	0	0	0	0	0	0	0	0.1	0.1	0.15	10	0	7	50.0	61.0%	13.19	0.059
96382531	A216	0	1	0	1	0	0	1	0	0	0	0.3			11	0	10	45.0			
	A217	0	0	1	0	0	0	0	0	0	0	0.1			13	2	12	35.0			
	A218	0	0	0	0	0	0	0	4	0	2	0.6			11	2	9	45.0			
	A219	0	1	0	0	2	0	2	0	0	0	0.5			7	0	5	65.0			
	A220	0	1	0	0	0	0	0	2	0	0	0.3	0.4	0.17	12	3	11	40.0	46.0%	10.20	0.239
96382533	A221	0	2	0	0	0	0	0	0	0	0	0.2			11	1	10	45.0			
	A222	1	1	0	0	1	0	0	0	1	0	0.4			4	3	1	80.0			
	A223	0	0	0	1	0	0	0	0	0	0	0.1			6	2	4	70.0			
	A224	0	0	0	0	0	0	0	0	0	0	0.0			13	0	9	35.0			
	A225	0	0	0	0	0	0	0	0	0	0	0.0	0.1	0.15	15	0	15	25.0	51.0%	20.83	0.188
96382534	A226	0	0	0	0	0	0	0	0	0	0	0.0			8	0	6	60.0			
	A227	0	0	1	0	0	0	0	0	0	0	0.1			14	0	10	30.0			
	A228	0	0	0	0	0	0	0	0	0	0	0.0			9	0	6	55.0			
	A229	0	0	0	0	0	0	0	0	0	0	0.0			9	0	5	55.0			
	A230	0	0	1	0	0	0	1	0	0	0	0.2	0.1	0.08	17	1	9	15.0	43.0%	17.49	0.326
96382545	A231	0	1	0	1	1	1	12	13	12	1	4.2			7	4	4	65.0			
	A232	0	0	1	0	0	0	0	0	0	0	0.1			9	0	5	55.0			
	A233	0	0	0	1	0	0	0	0	0	0	0.1			8	0	7	60.0			
	A234	1	0	0	0	0	0	0	0	0	0	0.1			3	0	2	85.0			
	A235	0	3	0	3	2	0	0	0	0	0	0.8	1.1	1.59	5	4	1	75.0	68.0%	10.77	0.028
96382535	A236	0	0	0	0	0	0	8	12	0	0	2.0			9	1	6	55.0			
	A237	0	0	0	0	0	0	0	0	0	0	0.0			5	3	2	75.0			
	A238	0	1	0	0	0	0	0	0	0	0	0.1			7	0	5	65.0			
	A239	1	0	0	0	0	0	0	0	0	0	0.1			13	0	8	35.0			
	A240	0	0	1	0	0	0	0	0	0	0	0.1	0.5	0.77	15	1	11	25.0	51.0%	18.55	0.178

Weston PSR, *Ampelisca abdita* bioassay, 26 September - 6 October 1996

Sample	Rep.	Visible D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	Mean Emerg	Sample Mean Emerg	Emerg St Dev	Alive	Dead	Reburial	% Mortality	Sample % Mortality	Mortality St Dev	P-Value
96382537	A241	0	0	0	1	1	0	0	0	1	0	0.3			6	1	2	70.0			
	A242	0	0	0	0	1	0	0	1	0	0	0.2			5	1	4	75.0			
	A243	0	0	2	1	1	0	1	0	0	0	0.5			3	1	3	85.0			
	A244	0	0	0	0	1	1	1	0	0	0	0.3			7	1	5	65.0			
	A245	0	0	0	1	0	0	0	0	0	0	0.1	0.3	0.13	7	0	6	65.0	72.0%	7.48	0.019
96382541	A246	0	1	0	1	0	1	1	0	0	0	0.4			8	1	4	60.0			
	A247	0	0	0	0	1	0	0	0	1	0	0.2			11	0	6	45.0			
	A248	0	0	0	1	0	0	0	0	0	0	0.1			11	0	7	45.0			
	A249	0	0	0	0	2	0	0	1	0	0	0.3			16	2	12	20.0			
	A250	0	0	0	1	1	0	1	0	0	0	0.3	0.3	0.10	11	0	9	45.0	43.0%	12.88	0.314
96382543	A251	0	0	0	0	0	0	0	0	0	0	0.0			13	0	9	35.0			
	A252	0	0	0	0	0	0	0	0	0	0	0.0			15	0	11	25.0			
	A253	0	1	0	3	0	0	1	0	0	0	0.5			18	0	12	10.0			
	A254	0	0	0	0	0	0	0	0	0	1	0.1			11	0	7	45.0			
	A255	0	0	0	0	0	0	0	0	0	0	0.0	0.1	0.19	6	0	4	70.0	37.0%	20.15	0.475
96382546	A256	0	0	0	0	0	0	0	0	2	0	0.2			9	3	5	55.0			
	A257	0	0	0	0	0	0	0	0	0	0	0.0			14	0	11	30.0			
	A258	0	0	0	0	0	0	2	0	0	0	0.2			9	0	6	55.0			
	A259	0	0	0	0	0	0	0	0	0	0	0.0			15	1	14	25.0			
	A260	1	0	1	0	0	0	0	0	0	0	0.2	0.1	0.10	11	7	9	45.0	42.0%	12.49	0.337
96382552	A261	0	0	0	0	0	0	0	0	0	0	0.0			19	0	16	5.0			
	A262	0	0	0	0	0	0	0	0	0	0	0.0			9	3	5	55.0			
	A263	0	0	0	0	0	0	0	0	0	0	0.0			13	1	9	35.0			
	A264	0	0	0	0	0	0	0	0	0	0	0.0			6	1	6	70.0			
	A265	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.00	17	0	15	15.0	36.0%	24.17	
Reference Toxicant (CdCl2)																					
Con A	1	--	--	--	--	--	--	--	--	--	--	--	--	--	9	1	--	10.0	5.0%	--	--
Con B	2	--	--	--	--	--	--	--	--	--	--	--	--	--	10	0	--	0.0		--	--
0.0937 mg/L	1	--	--	--	--	--	--	--	--	--	--	--	--	--	8	2	--	20.0	10.0%	--	--
0.0937 mg/L	2	--	--	--	--	--	--	--	--	--	--	--	--	--	10	0	--	0.0		--	--
0.1875 mg/L	1	--	--	--	--	--	--	--	--	--	--	--	--	--	7	2	--	30.0	25.0%	--	--
0.1875 mg/L	2	--	--	--	--	--	--	--	--	--	--	--	--	--	8	1	--	20.0		--	--
0.375 mg/L	1	--	--	--	--	--	--	--	--	--	--	--	--	--	8	2	--	20.0	30.0%	--	--
0.375 mg/L	2	--	--	--	--	--	--	--	--	--	--	--	--	--	6	3	--	40.0		--	--
0.75 mg/L	1	--	--	--	--	--	--	--	--	--	--	--	--	--	5	5	--	50.0	60.0%	--	--
0.75 mg/L	2	--	--	--	--	--	--	--	--	--	--	--	--	--	3	5	--	70.0		--	--
1.5 mg/L	1	--	--	--	--	--	--	--	--	--	--	--	--	--	1	9	--	90.0	95.0%	--	--
1.5 mg/L	2	--	--	--	--	--	--	--	--	--	--	--	--	--	0	10	--	100.0		--	--

1/ Note: Station standard deviations calculated on raw, untransformed data.

Echinoderm Acute Bioassay

Station			Normal	Abnormal	Total Survival	Combined % Mort./Abnorm.	Combined Replicate % Mort./Abnorm.	Combined Station % Mort./Abnorm.	Station Mort./Abnorm. Standard Deviation 1/	% Abnormality	Replicate % Abnormality	Station % Abnormality	Station Abnormality Standard Deviation 1/	P-value
Initial Counts			227											
			228											
			252											
			199											
			231											
			219											
			144											
			211											
			255											
			217			Initial seawater average count is 218								
Control	*E201*	*1*	*166*	*15*	*181*	% Normal Survival	80.9%			8.3				
		2	175	16	191	% Abnormal =	8.0%			8.4				
	E202	1	204	15	219					6.8				
		2	186	11	197					5.6				
	E203	1	113	14	127					11.0				
		2	130	12	142					8.5				
	E204	1	171	20	191	Final seawater control count is 177				10.5				
		2	203	21	224					9.4				
	E205	1	210	18	228	This number is used as 100% survival for all further				7.9				
		2	209	12	221	comparisons.				5.4		8.2	1.9	
96382526	E206	1	189	16	205	0.0				7.8				
		2	210	10	220	0.0	0.0			4.5	6.2			
	E207	1	148	10	158	16.2				6.3				
		2	147	11	158	16.8	16.5			7.0	6.6			
	E208	1	128	5	133	27.6				3.8				
		2	107	4	111	39.4	33.5			3.6	3.7			
	E209	1	238	6	244	0.0				2.5				
		2	228	4	232	0.0	0.0			1.7	2.1			
	E210	1	223	15	238	0.0				6.3				
		2	217	13	230	0.0	0.0	10.0	14.4	5.7	6.0	4.9	2.0	0.01
96382529	E211	1	183	13	196	0.0				6.6				
		2	239	9	248	0.0	0.0			3.6	5.1			
	E212	1	114	8	122	35.5				6.6				
		2	130	4	134	26.4	31.0			3.0	4.8			
	E213	1	164	14	178	7.2				7.9				
		2	181	14	195	0.0	3.6			7.2	7.5			
	E214	1	182	15	197	0.0				7.6				
		2	169	11	180	4.4	2.2			6.1	6.9			
	E215	1	148	5	153	16.2				3.3				
		2	144	20	164	18.5	17.4	10.8	12.8	12.2	7.7	6.4	2.7	0.01

Weston PSR - Echinoderm bioassay, 26-29 September 1996

Station			Normal	Abnormal	Total Survival	Combined % Mort./Abnorm.	Combined Replicate % Mort./Abnorm.	Combined Station % Mort./Abnorm.	Station Mort./Abnorm. Standard Deviation 1/	% Abnormality	Replicate % Abnormality	Station % Abnormality	Station Abnormality Standard Deviation 1/	P-value
96382531	E216	1	126	12	138	28.7				8.7				
		2	127	8	135	28.1	28.4			5.9	7.3			
	E217	1	129	3	132	27.0				2.3				
		2	139	10	149	21.3	24.2			6.7	4.5			
	E218	1	136	11	147	23.0				7.5				
		2	119	14	133	32.7	27.8			10.5	9.0			
	E219	1	131	8	139	25.9				5.8				
		2	130	11	141	26.4	26.1			7.8	6.8			
	E220	1	99	12	111	44.0				10.8				
		2	136	11	147	23.0	33.5	28.0	6.5	7.5	9.1	7.3	2.5	0.15
96382533	E221	1	181	17	198	0.0				8.6				
		2	183	9	192	0.0	0.0			4.7	6.6			
	E222	1	136	6	142	23.0				4.2				
		2	118	8	126	33.2	28.1			6.3	5.3			
	E223	1	146	12	158	17.4				7.6				
		2	171	17	188	3.2	10.3			9.0	8.3			
	E224	1	187	16	203	0.0				7.9				
		2	184	12	196	0.0	0.0			6.1	7.0			
	E225	1	136	16	152	23.0				10.5				
		2	121	13	134	31.5	27.3	13.1	13.9	9.7	10.1	7.5	2.1	0.02
96382534	E226	1	203	20	223	0.0				9.0				
		2	177	11	188	0.0	0.0			5.9	7.4			
	E227	1	119	15	134	32.7				11.2				
		2	123	5	128	30.4	31.5			3.9	7.6			
	E228	1	117	10	127	33.8				7.9				
		2	134	9	143	24.2	29.0			6.3	7.1			
	E229	1	125	15	140	29.3				10.7				
		2	147	21	168	16.8	23.0			12.5	11.6			
	E230	1	153	16	169	13.4				9.5				
		2	123	23	146	30.4	21.9	21.1	13.0	15.8	12.6	9.3	3.5	0.06
96382535	E231	1	183	18	201	0.0				9.0				
		2	167	18	185	5.5	2.7			9.7	9.3			
	E232	1	125	5	130	29.3				3.8				
		2	88	10	98	50.2	39.7			10.2	7.0			
	E233	1	90	16	106	49.1				15.1				
		2	99	11	110	44.0	46.5			10.0	12.5			
	E234	1	93	8	101	47.4				7.9				
		2	98	6	104	44.5	46.0			5.8	6.8			
	E235	1	122	9	131	31.0				6.9				
		2	149	8	157	15.7	23.3	31.7	18.7	5.1	6.0	8.3	3.2	0.32

Weston PSR - Echinoderm bioassay, 26-29 September 1996

Station			Normal	Abnormal	Total Survival	Combined % Mort./Abnorm.	Combined Replicate % Mort./Abnorm.	Combined Station % Mort./Abnorm.	Station Mort./Abnorm. Standard Deviation 1/	% Abnormality	Replicate % Abnormality	Station % Abnormality	Station Abnormality Standard Deviation 1/	P-value
96382537	E236	1	156	23	179	11.7				12.8				
		2	156	23	179	11.7	11.7			12.8	12.8			
	E237	1	122	26	148	31.0				17.6				
		2	137	21	158	22.5	26.7			13.3	15.4			
	E238	1	70	20	90	60.4				22.2				
		2	62	13	75	64.9	62.6			17.3	19.8			
	E239	1	92	17	109	47.9				15.6				
		2	84	18	102	52.5	50.2			17.6	16.6			
	E240	1	75	36	111	57.6				32.4				
		2	83	35	118	53.0	55.3	41.3	20.3	29.7	31.0	19.1	6.9	0.37
96382541	E241	1	92	26	118	47.9				22.0				
		2	119	34	153	32.7	40.3			22.2	22.1			
	E242	1	98	43	141	44.5				30.5				
		2	97	25	122	45.1	44.8			20.5	25.5			
	E243	1	82	18	100	53.6				18.0				
		2	64	23	87	63.8	58.7			26.4	22.2			
	E244	1	117	33	150	33.8				22.0				
		2	85	50	135	51.9	42.8			37.0	29.5			
	E245	1	74	25	99	58.1				25.3				
		2	73	31	104	58.7	58.4	49.0	10.3	29.8	27.5	25.4	5.7	0.10
96382543	E246	1	166	15	181	6.1				8.3				
		2	195	11	206	0.0	3.0			5.3	6.8			
	E247	1	132	9	141	25.3				6.4				
		2	157	17	174	11.1	18.2			9.8	8.1			
	E248	1	137	23	160	22.5				14.4				
		2	162	21	183	8.3	15.4			11.5	12.9			
	E249	1	122	21	143	31.0				14.7				
		2	113	16	129	36.0	33.5			12.4	13.5			
	E250	1	152	33	185	14.0				17.8				
		2	155	33	188	12.3	13.1	16.7	11.6	17.6	17.7	11.8	4.4	0.03
96382545	E251	1	46	2	48	74.0				4.2				
		2	41	3	44	76.8	75.4			6.8	5.5			
	E252	1	29	5	34	83.6				14.7				
		2	39	5	44	77.9	80.8			11.4	13.0			
	E253	1	70	19	89	60.4				21.3				
		2	83	10	93	53.0	56.7			10.8	16.1			
	E254	1	33	5	38	81.3				13.2				
		2	26	8	34	85.3	83.3			23.5	18.3			
	E255	1	47	7	54	73.4				13.0				
		2	28	10	38	84.2	78.8	75.0	10.6	26.3	19.6	14.5	7.2	0.00

Weston PSR - Echinoderm bioassay, 26-29 September 1996

Station			Normal	Abnormal	Total Survival	Combined % Mort./Abnorm.	Combined Replicate % Mort./Abnorm.	Combined Station % Mort./Abnorm.	Station Mort./Abnorm. Standard Deviation 1/	% Abnormality	Replicate % Abnormality	Station % Abnormality	Station Abnormality Standard Deviation 1/	P-value
96382546	E256	1	76	14	90	57.0				15.6				
		2	44	9	53	75.1	66.0			17.0	16.3			
	E257	1	59	12	71	66.6				16.9				
		2	48	4	52	72.8	69.7			7.7	12.3			
	E258	1	104	8	112	41.1				7.1				
		2	50	8	58	71.7	56.4			13.8	10.5			
	E259	1	63	4	67	64.3				6.0				
		2	50	5	55	71.7	68.0			9.1	7.5			
	E260	1	71	6	77	59.8				7.8				
		2	64	8	72	63.8	61.8	64.4	10.1	11.1	9.5	11.2	4.3	0.01
96382552	E261	1	85	4	89	51.9				4.5				
		2	88	9	97	50.2	51.0			9.3	6.9			
	E262	1	156	13	169	11.7				7.7				
		2	145	15	160	17.9	14.8			9.4	8.5			
	E263	1	91	9	100	48.5				9.0				
		2	74	9	83	58.1	53.3			10.8	9.9			
	E264	1	87	26	113	50.8				23.0				
		2	123	25	148	30.4	40.6			16.9	20.0			
	E265	1	128	19	147	27.6				12.9				
		2	136	15	151	23.0	25.3	37.0	16.6	9.9	11.4	11.3	5.2	

Station	Normal	Abnormal	Total Survival	Combined % Mort./Abnorm.	Combined Replicate % Mort./Abnorm.	Combined Station % Mort./Abnorm.	Station Mort./Abnorm. Standard Deviation 1/	% Abnormality	Replicate % Abnormality	Station % Abnormality	Station Abnormality Standard Deviation 1/	P-value
Reference Toxicant (CdCl2)												
0.0 mg/L	184	19	203	0.0				9.4				
	208	30	238	0.0				12.6				
	181	15	196	0.0				7.7				
	168	23	191	4.9		1.2	2.5	12.0		10.4		
2.6 mg/L	160	32	192	9.5				16.7				
	179	33	212	0.0				15.6				
	171	47	218	3.2				21.6				
	173	54	227	2.1		3.7	4.1	23.8		19.4		
4.3 mg/L	112	47	159	36.6				29.6				
	116	54	170	34.4				31.8				
	123	43	166	30.4				25.9				
	117	47	164	33.8		33.8	2.6	28.7		29.0		
7.2 mg/L	131	54	185	25.9				29.2				
	122	55	177	31.0				31.1				
	153	61	214	13.4				28.5				
	155	51	206	12.3		20.6	9.2	24.8		28.4		
12 mg/L	71	96	167	59.8				57.5				
	63	111	174	64.3				63.8				
	63	159	222	64.3				71.6				
	68	117	185	61.5		62.5	2.2	63.2		64.0		
20.0 mg/L	10	156	166	94.3				94.0				
	11	160	171	93.8				93.6				
	9	148	157	94.9				94.3				
	10	141	151	94.3		94.3	0.5	93.4		93.8		

1/ Note: Station standard deviations calculated on raw, untransformed data.

Clam Mortality and Growth Bioassay

Station	Lab ID	Rep	Length Ti	Length Tf	Net Growth (mm)	Mean Net Growth Length	St Dev Net Growth Length	P-value	Growth Ti	Growth Tf	Weight Growth Rate (mg/day)	Mean Weight Growth Rate	St Dev Weight Growth Rate	P-value
Control	Tank 8	1	41	41	0	0.2	0.5		8.9	8.6	-0.011	-0.005	0.008	
Control	Tank 8	2	32	32	0				4	3.8	-0.007			
Control	Tank 8	3	36	36	0				5.6	5.3	-0.011			
Control	Tank 8	4	34	34	0				5.6	5.6	0.000			
Control	Tank 8	5	36	37	1				6.3	6.1	-0.007			
Control	Tank 8	6	44	44	0				11.2	10.5	-0.025			
Control	Tank 8	7	31	31	0				4.4	4.2	-0.007			
Control	Tank 8	8	38	38	0				6.8	6.8	0.000			
Control	Tank 8	9	31	31	0				3.9	3.7	-0.007			
Control	Tank 8	10	36	36	0				5.6	5.4	-0.007			
Control	Tank 8	11	30	30	0				3.6	3.5	-0.004			
Control	Tank 8	12	39	39	0				7.5	7.2	-0.011			
Control	Tank 8	13	36	36	0				6.2	6	-0.007			
Control	Tank 8	14	35	35	0				6.7	6.6	-0.004			
Control	Tank 8	15	30	30	0				3.6	3.4	-0.007			
Control	Tank 8	16	29	29	0				3.6	3.2	-0.014			
Control	Tank 8	17	29	29	0				3.5	3.7	0.007			
Control	Tank 8	18	33	34	1				4.7	4.7	0.000			
Control	Tank 8	19	41	41	0				9	8.9	-0.004			
Control	Tank 8	20	30	30	0				3.8	3.5	-0.011			
Control	Tank 15	1	43	44	1				9.6	9.5	-0.004			
Control	Tank 15	2	30	32	2				4.5	4.5	0.000			
Control	Tank 15	3	28	28	0				3.6	3.5	-0.004			
Control	Tank 15	4	32	32	0				4.3	4.1	-0.007			
Control	Tank 15	5	31	31	0				4.3	4.3	0.000			
Control	Tank 15	6	36	36	0				6.7	7.3	0.021			
Control	Tank 15	7	33	33	0				4.9	4.7	-0.007			
Control	Tank 15	8	32	32	0				4.9	4.8	-0.004			
Control	Tank 15	9	33	33	0				4.8	4.7	-0.004			
Control	Tank 15	10	41	41	0				8.5	8.4	-0.004			
Control	Tank 15	11	32	32	0				4.4	3.6	-0.029			
Control	Tank 15	12	33	34	1				4.9	5.1	0.007			
Control	Tank 15	13	34	34	0				5.3	5.3	0.000			
Control	Tank 15	14	35	35	0				5.6	5.5	-0.004			
Control	Tank 15	15	43	*					11	*				
Control	Tank 15	16	28	28	0				3.4	3.4	0.000			
Control	Tank 15	17	39	40	1				8.7	8.3	-0.014			
Control	Tank 15	18	43	44	1				13.8	13.1	-0.025			
Control	Tank 15	19	42	43	1				12.2	11.6	-0.021			
Control	Tank 15	20	44	44	0				13.7	13.5	-0.007			

Ti = Time Initial
Tf = Time Final
* = Dead clam

Weston Bioaccumulation Study

Station	Lab ID	Rep	Length Ti	Length Tf	Net Growth (mm)	Mean Net Growth Length	St Dev Net Growth Length	P-value	Growth Ti	Growth Tf	Weight Growth Rate (mg/day)	Mean Weight Growth Rate	St Dev Weight Growth Rate	P-value
Control	Tank 23	1	35	35	0				5	4.8	-0.007			
Control	Tank 23	2	36	36	0				5.7	5.5	-0.007			
Control	Tank 23	3	35	35	0				6.5	6.4	-0.004			
Control	Tank 23	4	31	31	0				4.4	4.4	0.000			
Control	Tank 23	5	36	38	2				6.5	6.3	-0.007			
Control	Tank 23	6	33	33	0				4.1	4.2	0.004			
Control	Tank 23	7	40	40	0				8.1	8	-0.004			
Control	Tank 23	8	40	41	1				9.3	9.1	-0.007			
Control	Tank 23	9	34	34	0				4.9	4.8	-0.004			
Control	Tank 23	10	32	32	0				4.2	4.1	-0.004			
Control	Tank 23	11	31	31	0				3.7	3.5	-0.007			
Control	Tank 23	12	30	30	0				3.7	3.6	-0.004			
Control	Tank 23	13	34	34	0				4.8	4.7	-0.004			
Control	Tank 23	14	31	31	0				3.6	3.7	0.004			
Control	Tank 23	15	31	31	0				4	4.1	0.004			
Control	Tank 23	16	28	28	0				3	3.1	0.004			
Control	Tank 23	17	37	37	0				7.5	7.6	0.004			
Control	Tank 23	18	34	34	0				5.4	5.4	0.000			
Control	Tank 23	19	31	31	0				3.8	4	0.007			
Control	Tank 23	20	30	30	0				4.3	4.2	-0.004			
96382526	Tank 12	1	36	36	0	0.2	0.5	0.357	6.5	6.4	-0.004	-0.005	0.006	0.275
96382526	Tank 12	2	40	40	0				8.3	8.4	0.004			
96382526	Tank 12	3	33	33	0				4.4	4.2	-0.007			
96382526	Tank 12	4	34	34	0				4.6	4.4	-0.007			
96382526	Tank 12	5	33	35	2				6.2	6.1	-0.004			
96382526	Tank 12	6	31	32	1				4	4	0.000			
96382526	Tank 12	7	30	31	1				3.8	3.7	-0.004			
96382526	Tank 12	8	35	36	1				5.8	5.8	0.000			
96382526	Tank 12	9	37	38	1				7	6.9	-0.004			
96382526	Tank 12	10	39	39	0				7.1	7.2	0.004			
96382526	Tank 12	11	40	40	0				10.5	10.1	-0.014			
96382526	Tank 12	12	39	39	0				7.8	7.4	-0.014			
96382526	Tank 12	13	41	41	0				8.8	8.8	0.000			
96382526	Tank 12	14	34	34	0				4.8	4.8	0.000			
96382526	Tank 12	15	42	42	0				10.7	10.5	-0.007			
96382526	Tank 12	16	31	31	0				4.3	4.4	0.004			
96382526	Tank 12	17	37	37	0				7.1	6.9	-0.007			
96382526	Tank 12	18	41	*					9.4	*				
96382526	Tank 12	19	37	37	0				6.8	6.4	-0.014			
96382526	Tank 12	20	44	44	0				11.6	11.5	-0.004			

Ti = Time Initial
Tf = Time Final
* = Dea[illegible]n

Station	Lab ID	Rep	Length Ti	Length Tf	Net Growth (mm)	Mean Net Growth Length	St Dev Net Growth Length	P-value	Growth Ti	Growth Tf	Weight Growth Rate (mg/day)	Mean Weight Growth Rate	St Dev Weight Growth Rate	P-value
96382526	Tank 24	1	37	37	0				5.6	5.5	-0.004			
96382526	Tank 24	2	30	29	-1				3.5	3.3	-0.007			
96382526	Tank 24	3	43	43	0				10	9.9	-0.004			
96382526	Tank 24	4	41	41	0				10.5	10.2	-0.011			
96382526	Tank 24	5	36	36	0				6	6	0.000			
96382526	Tank 24	6	34	34	0				5.3	5.3	0.000			
96382526	Tank 24	7	43	43	0				10.2	9.9	-0.011			
96382526	Tank 24	8	36	36	0				6.4	6.1	-0.011			
96382526	Tank 24	9	30	30	0				3.5	3.5	0.000			
96382526	Tank 24	10	40	40	0				8.6	8.4	-0.007			
96382526	Tank 24	11	35	35	0				5.6	5.6	0.000			
96382526	Tank 24	12	31	31	0				4	3.8	-0.007			
96382526	Tank 24	13	42	42	0				10.5	11.1	0.021			
96382526	Tank 24	14	33	33	0				6	5.9	-0.004			
96382526	Tank 24	15	37	37	0				6.6	6.3	-0.011			
96382526	Tank 24	16	43	43	0				11.5	11.2	-0.011			
96382526	Tank 24	17	33	33	0				4.7	4.4	-0.011			
96382526	Tank 24	18	33	33	0				4.2	4.1	-0.004			
96382526	Tank 24	19	29	29	0				3.7	3.4	-0.011			
96382526	Tank 24	20	37	38	1				7.5	7.5	0.000			
96382526	Tank 32	1	44	45	1				12.9	12.9	0.000			
96382526	Tank 32	2	45	45	0				13.4	13.3	-0.004			
96382526	Tank 32	3	32	32	0				4.3	4	-0.011			
96382526	Tank 32	4	43	44	1				12.6	12.3	-0.011			
96382526	Tank 32	5	35	35	0				5.8	5.6	-0.007			
96382526	Tank 32	6	37	36	-1				6.4	5.9	-0.018			
96382526	Tank 32	7	37	36	-1				5.8	5.5	-0.011			
96382526	Tank 32	8	31	31	0				4.4	4.1	-0.011			
96382526	Tank 32	9	43	43	0				10.9	10.8	-0.004			
96382526	Tank 32	10	40	41	1				8.8	8.5	-0.011			
96382526	Tank 32	11	42	42	0				10.1	9.8	-0.011			
96382526	Tank 32	12	35	35	0				5	4.9	-0.004			
96382526	Tank 32	13	37	37	0				7.2	7	-0.007			
96382526	Tank 32	14	39	39	0				6.9	6.6	-0.011			
96382526	Tank 32	15	44	44	0				10.2	10.2	0.000			
96382526	Tank 32	16	30	31	1				3.7	3.5	-0.007			
96382526	Tank 32	17	29	30	1				4.1	3.8	-0.011			
96382526	Tank 32	18	36	37	1				5.7	5.5	-0.007			
96382526	Tank 32	19	36	36	0				6.4	6.3	-0.004			
96382526	Tank 32	20	34	34	0				5.2	5	-0.007			

Ti = Time Initial
Tf = Time Final
* = Dead clam

Station	Lab ID	Rep	Length Ti	Length Tf	Net Growth (mm)	Mean Net Growth Length	St Dev Net Growth Length	P-value	Growth Ti	Growth Tf	Weight Growth Rate (mg/day)	Mean Weight Growth Rate	St Dev Weight Growth Rate	P-value
96382529	Tank 14	1	35	36	1	0.0	0.4	0.004	5.9	5.8	-0.004	-0.001	0.008	0.008
96382529	Tank 14	2	28	28	0				2.2	3.2	0.036			
96382529	Tank 14	3	37	37	0				6.9	6.8	-0.004			
96382529	Tank 14	4	38	38	0				7.4	7.1	-0.011			
96382529	Tank 14	5	30	30	0				3.7	3.6	-0.004			
96382529	Tank 14	6	31	31	0				4.2	3.9	-0.011			
96382529	Tank 14	7	31	31	0				3.8	3.7	-0.004			
96382529	Tank 14	8	32	33	1				5	4.7	-0.011			
96382529	Tank 14	9	36	36	0				5.7	5.6	-0.004			
96382529	Tank 14	10	32	32	0				3.6	3.7	0.004			
96382529	Tank 14	11	36	36	0				6.7	6.5	-0.007			
96382529	Tank 14	12	36	35	-1				4.8	4.8	0.000			
96382529	Tank 14	13	32	32	0				4.7	4.5	-0.007			
96382529	Tank 14	14	32	31	-1				4.2	4.2	0.000			
96382529	Tank 14	15	39	40	1				7.4	7.1	-0.011			
96382529	Tank 14	16	35	35	0				5.3	5.1	-0.007			
96382529	Tank 14	17	32	32	0				4.5	4.4	-0.004			
96382529	Tank 14	18	37	37	0				6.4	6.7	0.011			
96382529	Tank 14	19	34	34	0				5	4.7	-0.011			
96382529	Tank 14	20	34	34	0				5.1	4.9	-0.007			
96382529	Tank 28	1	43	43	0				8.9	9	0.004			
96382529	Tank 28	2	40	40	0				10.2	10.7	0.018			
96382529	Tank 28	3	37	38	1				7	7.3	0.011			
96382529	Tank 28	4	41	41	0				8.6	8.4	-0.007			
96382529	Tank 28	5	31	31	0				4.8	4.6	-0.007			
96382529	Tank 28	6	34	34	0				5	4.8	-0.007			
96382529	Tank 28	7	32	32	0				4.5	4.5	0.000			
96382529	Tank 28	8	44	44	0				10.8	10.7	-0.004			
96382529	Tank 28	9	36	36	0				6.2	6.5	0.011			
96382529	Tank 28	10	34	34	0				5.1	5.2	0.004			
96382529	Tank 28	11	37	37	0				6.1	6	-0.004			
96382529	Tank 28	12	34	34	0				5.1	5.2	0.004			
96382529	Tank 28	13	32	32	0				5.2	5.2	0.000			
96382529	Tank 28	14	34	34	0				4.6	4.6	0.000			
96382529	Tank 28	15	43	43	0				8.7	8.8	0.004			
96382529	Tank 28	16	30	30	0				4	4.1	0.004			
96382529	Tank 28	17	36	36	0				5.8	5.8	0.000			
96382529	Tank 28	18	36	35	-1				5.4	5.2	-0.007			
96382529	Tank 28	19	35	35	0				6.3	6.2	-0.004			
96382529	Tank 28	20	37	37	0				6.2	6.3	0.004			

Ti = Time Initial
Tf = Time Final
* = Dead

Station	Lab ID	Rep	Length Ti	Length Tf	Net Growth (mm)	Mean Net Growth Length	St Dev Net Growth Length	P-value	Growth Ti	Growth Tf	Weight Growth Rate (mg/day)	Mean Weight Growth Rate	St Dev Weight Growth Rate	P-value
96382529	Tank 34	1	37	36	-1				6.2	6.2	0.000			
96382529	Tank 34	2	33	32	-1				5	4.8	-0.007			
96382529	Tank 34	3	38	38	0				6.3	6.2	-0.004			
96382529	Tank 34	4	34	34	0				5.2	5.4	0.007			
96382529	Tank 34	5	44	44	0				12.2	11.8	-0.014			
96382529	Tank 34	6	33	33	0				5	4.9	-0.004			
96382529	Tank 34	7	36	36	0				6.9	6.9	0.000			
96382529	Tank 34	8	34	34	0				4.9	5.1	0.007			
96382529	Tank 34	9	33	33	0				4.7	4.7	0.000			
96382529	Tank 34	10	32	32	0				4.8	4.8	0.000			
96382529	Tank 34	11	42	42	0				11.6	11.3	-0.011			
96382529	Tank 34	12	30	30	0				3.9	3.8	-0.004			
96382529	Tank 34	13	30	30	0				4.3	4.3	0.000			
96382529	Tank 34	14	28	28	0				2.9	2.8	-0.004			
96382529	Tank 34	15	29	29	0				3.2	3.2	0.000			
96382529	Tank 34	16	30	30	0				4.2	4.1	-0.004			
96382529	Tank 34	17	36	36	0				5.8	5.8	0.000			
96382529	Tank 34	18	33	33	0				5.5	5.5	0.000			
96382529	Tank 34	19	32	32	0				4.4	4.4	0.000			
96382529	Tank 34	20	33	33	0				4.5	4.5	0.000			
96382531	Tank 2	1	35	35	0	-0.1	0.5	0.001	5.5	5.4	-0.004	-0.001	0.009	0.013
96382531	Tank 2	2	33	33	0				4.5	4.4	-0.004			
96382531	Tank 2	3	44	44	0				12.5	12.4	-0.004			
96382531	Tank 2	4	36	35	-1				5.1	5.2	0.004			
96382531	Tank 2	5	38	38	0				7.6	7.7	0.004			
96382531	Tank 2	6	31	32	1				4.4	4.4	0.000			
96382531	Tank 2	7	35	35	0				5.3	5.3	0.000			
96382531	Tank 2	8	34	34	0				5.6	5.6	0.000			
96382531	Tank 2	9	43	43	0				9.7	9.7	0.000			
96382531	Tank 2	10	36	36	0				5.9	6	0.004			
96382531	Tank 2	11	38	38	0				8.6	8.9	0.011			
96382531	Tank 2	12	38	37	-1				7.6	7.7	0.004			
96382531	Tank 2	13	43	43	0				10	10	0.000			
96382531	Tank 2	14	36	37	1				5.6	6.3	0.025			
96382531	Tank 2	15	41	42	1				10.9	10.9	0.000			
96382531	Tank 2	16	39	39	0				8.9	9	0.004			
96382531	Tank 2	17	43	43	0				9.4	9.2	-0.007			
96382531	Tank 2	18	34	34	0				5.8	6	0.007			
96382531	Tank 2	19	36	36	0				5.1	5.2	0.004			
96382531	Tank 2	20	42	43	1				9.8	9.8	0.000			

Ti = Time Initial
Tf = Time Final
* = Dead clam

Station	Lab ID	Rep	Length Ti	Length Tf	Net Growth (mm)	Mean Net Growth Length	St Dev Net Growth Length	P-value	Growth Ti	Growth Tf	Weight Growth Rate (mg/day)	Mean Weight Growth Rate	St Dev Weight Growth Rate	P-value
96382531	Tank 6	1	38	38	0				7.8	7.7	-0.004			
96382531	Tank 6	2	36	36	0				6.9	6.7	-0.007			
96382531	Tank 6	3	34	34	0				5.1	4.8	-0.011			
96382531	Tank 6	4	40	40	0				9.7	9.6	-0.004			
96382531	Tank 6	5	33	33	0				5.1	4.8	-0.011			
96382531	Tank 6	6	32	31	-1				3.1	4.4	0.046			
96382531	Tank 6	7	36	35	-1				5.8	5.4	-0.014			
96382531	Tank 6	8	33	32	-1				4.2	3.9	-0.011			
96382531	Tank 6	9	42	42	0				9.7	9.5	-0.007			
96382531	Tank 6	10	35	36	1				5.9	5.7	-0.007			
96382531	Tank 6	11	36	36	0				6.1	5.7	-0.014			
96382531	Tank 6	12	36	36	0				7.2	6.9	-0.011			
96382531	Tank 6	13	40	40	0				7.5	7.4	-0.004			
96382531	Tank 6	14	36	36	0				7	6.8	-0.007			
96382531	Tank 6	15	35	35	0				5	4.7	-0.011			
96382531	Tank 6	16	34	33	-1				5.6	5.4	-0.007			
96382531	Tank 6	17	38	38	0				6.9	6.8	-0.004			
96382531	Tank 6	18	34	34	0				4.8	4.7	-0.004			
96382531	Tank 6	19	33	33	0				4.4	4.4	0.000			
96382531	Tank 6	20	36	36	0				5.6	5.6	0.000			
96382531	Tank 16	1	32	32	0				5.2	5.3	0.004			
96382531	Tank 16	2	39	38	-1				8	7.9	-0.004			
96382531	Tank 16	3	42	42	0				10.5	10.4	-0.004			
96382531	Tank 16	4	32	32	0				4.3	4.1	-0.007			
96382531	Tank 16	5	42	42	0				11.5	11.4	-0.004			
96382531	Tank 16	6	41	41	0				8.8	8.8	0.000			
96382531	Tank 16	7	34	33	-1				5.5	5.4	-0.004			
96382531	Tank 16	8	31	31	0				4.8	4.8	0.000			
96382531	Tank 16	9	38	37	-1				6.9	6.8	-0.004			
96382531	Tank 16	10	43	43	0				11	10.6	-0.014			
96382531	Tank 16	11	29	29	0				3.3	3.3	0.000			
96382531	Tank 16	12	42	42	0				8.2	8.8	0.021			
96382531	Tank 16	13	36	36	0				6.7	6.6	-0.004			
96382531	Tank 16	14	35	35	0				5.6	5.6	0.000			
96382531	Tank 16	15	44	44	0				13	13.1	0.004			
96382531	Tank 16	16	33	33	0				4.9	5	0.004			
96382531	Tank 16	17	38	37	-1				7.1	6.9	-0.007			
96382531	Tank 16	18	34	34	0				5.6	5.5	-0.004			
96382531	Tank 16	19	33	33	0				5	5.1	0.004			
96382531	Tank 16	20	40	39	-1				8.3	8.2	-0.004			

Ti = Time Initial
Tf = Time Final
• = Dead

Station	Lab ID	Rep	Length Ti	Length Tf	Net Growth (mm)	Mean Net Growth Length	St Dev Net Growth Length	P-value	Growth Ti	Growth Tf	Weight Growth Rate (mg/day)	Mean Weight Growth Rate	St Dev Weight Growth Rate	P-value
96382533	Tank 4	1	33	33	0	0.1	0.4	0.056	5	5	0.000	-0.001	0.007	0.013
96382533	Tank 4	2	31	31	0				4.4	4.6	0.007			
96382533	Tank 4	3	29	29	0				3.4	3.3	-0.004			
96382533	Tank 4	4	31	31	0				3.9	3.8	-0.004			
96382533	Tank 4	5	30	30	0				3.3	3.4	0.004			
96382533	Tank 4	6	33	33	0				4.8	4.8	0.000			
96382533	Tank 4	7	30	30	0				3.7	3.8	0.004			
96382533	Tank 4	8	30	30	0				3.7	3.7	0.000			
96382533	Tank 4	9	30	30	0				3.7	3.9	0.007			
96382533	Tank 4	10	29	29	0				4.2	4.3	0.004			
96382533	Tank 4	11	32	32	0				4.2	4.1	-0.004			
96382533	Tank 4	12	39	39	0				7.5	7.4	-0.004			
96382533	Tank 4	13	35	35	0				6.4	6.8	0.014			
96382533	Tank 4	14	35	35	0				5.3	5.6	0.011			
96382533	Tank 4	15	37	37	0				6.4	6.4	0.000			
96382533	Tank 4	16	41	41	0				10.1	10.2	0.004			
96382533	Tank 4	17	37	36	-1				6.2	6.5	0.011			
96382533	Tank 4	18	44	45	1				13.6	13.5	-0.004			
96382533	Tank 4	19	40	40	0				9	9.2	0.007			
96382533	Tank 4	20	40	41	1				10	9.9	-0.004			
96382533	Tank 22	1	39	40	1				8.1	7.9	-0.007			
96382533	Tank 22	2	44	44	0				10.2	10.5	0.011			
96382533	Tank 22	3	40	40	0				8.9	8.7	-0.007			
96382533	Tank 22	4	30	31	1				4	3.8	-0.007			
96382533	Tank 22	5	33	34	1				4.8	4.7	-0.004			
96382533	Tank 22	6	34	34	0				5.8	5.8	0.000			
96382533	Tank 22	7	44	44	0				10.3	10.2	-0.004			
96382533	Tank 22	8	31	32	1				4.4	4.4	0.000			
96382533	Tank 22	9	35	35	0				6.7	6.5	-0.007			
96382533	Tank 22	10	43	44	1				12.1	11.8	-0.011			
96382533	Tank 22	11	39	39	0				7.4	7.4	0.000			
96382533	Tank 22	12	37	37	0				8	7.9	-0.004			
96382533	Tank 22	13	34	34	0				4.8	4.9	0.004			
96382533	Tank 22	14	44	45	1				12.1	12	-0.004			
96382533	Tank 22	15	32	32	0				4.2	4.3	0.004			
96382533	Tank 22	16	32	32	0				4.1	4	-0.004			
96382533	Tank 22	17	30	30	0				3.7	3.5	-0.007			
96382533	Tank 22	18	40	40	0				8.2	8.2	0.000			
96382533	Tank 22	19	29	29	0				3.6	3.4	-0.007			
96382533	Tank 22	20	30	30	0				4.2	4	-0.007			

Ti = Time Initial
Tf = Time Final
* = Dead clam

Station	Lab ID	Rep	Length Ti	Length Tf	Net Growth (mm)	Mean Net Growth Length	St Dev Net Growth Length	P-value	Growth Ti	Growth Tf	Weight Growth Rate (mg/day)	Mean Weight Growth Rate	St Dev Weight Growth Rate	P-value
96382533	Tank 26	1	29	29	0				3.2	3.1	-0.004			
96382533	Tank 26	2	28	28	0				3	3.1	0.004			
96382533	Tank 26	3	40	40	0				10	9.7	-0.011			
96382533	Tank 26	4	30	30	0				3.6	3.5	-0.004			
96382533	Tank 26	5	32	32	0				4.3	4.2	-0.004			
96382533	Tank 26	6	44	44	0				11.4	11.3	-0.004			
96382533	Tank 26	7	34	34	0				5.5	5.6	0.004			
96382533	Tank 26	8	36	36	0				5.7	5.6	-0.004			
96382533	Tank 26	9	37	37	0				6.3	6.4	0.004			
96382533	Tank 26	10	35	35	0				5.8	5.6	-0.007			
96382533	Tank 26	11	34	34	0				5.4	5.5	0.004			
96382533	Tank 26	12	40	40	0				8.9	8.7	-0.007			
96382533	Tank 26	13	33	33	0				4.3	4.2	-0.004			
96382533	Tank 26	14	30	29	-1				3.7	3.6	-0.004			
96382533	Tank 26	15	40	39	-1				6.9	5.9	-0.036			
96382533	Tank 26	16	37	36	-1				6.2	6.1	-0.004			
96382533	Tank 26	17	35	35	0				5.3	5.2	-0.004			
96382533	Tank 26	18	35	35	0				4.9	4.9	0.000			
96382533	Tank 26	19	37	37	0				7	6.7	-0.011			
96382533	Tank 26	20	33	33	0				4.8	5.1	0.011			
96382534	Tank 9	1	37	36	-1	0.1	0.5	0.052	6.9	7.2	0.011	0.000	0.032	0.130
96382534	Tank 9	2	40	40	0				8.2	8.1	-0.004			
96382534	Tank 9	3	33	33	0				5.2	5.4	0.007			
96382534	Tank 9	4	35	35	0				4.9	4.9	0.000			
96382534	Tank 9	5	40	39	-1				8.9	8.8	-0.004			
96382534	Tank 9	6	30	30	0				3.5	3.5	0.000			
96382534	Tank 9	7	36	35	-1				5.9	5.8	-0.004			
96382534	Tank 9	8	40	40	0				9	8.8	-0.007			
96382534	Tank 9	9	44	44	0				13.5	14	0.018			
96382534	Tank 9	10	37	37	0				6.2	6.2	0.000			
96382534	Tank 9	11	33	33	0				4.9	4.9	0.000			
96382534	Tank 9	12	31	31	0				3.8	3.9	0.004			
96382534	Tank 9	13	39	39	0				6.9	6.7	-0.007			
96382534	Tank 9	14	31	31	0				4.4	4.4	0.000			
96382534	Tank 9	15	31	31	0				3.6	3.6	0.000			
96382534	Tank 9	16	32	32	0				3.8	3.7	-0.004			
96382534	Tank 9	17	40	40	0				9.4	9.3	-0.004			
96382534	Tank 9	18	35	35	0				5.5	5.4	-0.004			
96382534	Tank 9	19	35	35	0				6.5	6.5	0.000			
96382534	Tank 9	20	42	42	0				9.9	10.1	0.007			

Ti = Time Initial
Tf = Tim[illegible]al
• = Dead

Station	Lab ID	Rep	Length Ti	Length Tf	Net Growth (mm)	Mean Net Growth Length	St Dev Net Growth Length	P-value	Growth Ti	Growth Tf	Weight Growth Rate (mg/day)	Mean Weight Growth Rate	St Dev Weight Growth Rate	P-value
96382534	Tank 20	1	41	41	0				9.9	9.7	-0.007			
96382534	Tank 20	2	41	40	-1				8.1	8.2	0.004			
96382534	Tank 20	3	34	34	0				5.6	5.5	-0.004			
96382534	Tank 20	4	43	43	0				10.2	10.4	0.007			
96382534	Tank 20	5	34	34	0				5.1	5.6	0.018			
96382534	Tank 20	6	36	36	0				6.7	7	0.011			
96382534	Tank 20	7	34	34	0				4.9	5	0.004			
96382534	Tank 20	8	31	31	0				4.3	4.3	0.000			
96382534	Tank 20	9	30	30	0				4	4	0.000			
96382534	Tank 20	10	33	33	0				4.3	4.3	0.000			
96382534	Tank 20	11	32	32	0				3.7	3.6	-0.004			
96382534	Tank 20	12	44	45	1				11.1	11.4	0.011			
96382534	Tank 20	13	37	37	0				6.8	6.8	0.000			
96382534	Tank 20	14	34	34	0				6.4	6.4	0.000			
96382534	Tank 20	15	33	33	0				4.8	4.7	-0.004			
96382534	Tank 20	16	32	32	0				4.8	4.6	-0.007			
96382534	Tank 20	17	42	41	-1				10.8	10.7	-0.004			
96382534	Tank 20	18	32	32	0				4.3	9.1	0.171			
96382534	Tank 20	19	42	42	0				9.2	4.3	-0.175			
96382534	Tank 20	20	32	32	0				4.5	4.4	-0.004			
96382534	Tank 31	1	32	33	1				4.7	4.7	0.000			
96382534	Tank 31	2	32	32	0				4.1	4.1	0.000			
96382534	Tank 31	3	35	35	0				6.8	6.8	0.000			
96382534	Tank 31	4	32	32	0				4	4	0.000			
96382534	Tank 31	5	32	33	1				4.5	4.5	0.000			
96382534	Tank 31	6	42	42	0				10.6	10.3	-0.011			
96382534	Tank 31	7	29	29	0				3.9	3.7	-0.007			
96382534	Tank 31	8	29	29	0				3.2	3.1	-0.004			
96382534	Tank 31	9	33	33	0				4.9	4.8	-0.004			
96382534	Tank 31	10	30	32	2				4	4	0.000			
96382534	Tank 31	11	40	41	1				8.9	9.3	0.014			
96382534	Tank 31	12	32	31	-1				4.1	4	-0.004			
96382534	Tank 31	13	38	38	0				6.8	6.8	0.000			
96382534	Tank 31	14	33	33	0				4.4	4.3	-0.004			
96382534	Tank 31	15	30	30	0				3.5	3.5	0.000			
96382534	Tank 31	16	28	29	1				3.2	3.4	0.007			
96382534	Tank 31	17	30	30	0				3.5	3.7	0.007			
96382534	Tank 31	18	38	38	0				8.5	8.2	-0.011			
96382534	Tank 31	19	31	32	1				4.4	4.3	-0.004			
96382534	Tank 31	20	39	40	1				10	10.1	0.004			

Ti = Time Initial
Tf = Time Final
* = Dead clam

Station	Lab ID	Rep	Length Ti	Length Tf	Net Growth (mm)	Mean Net Growth Length	St Dev Net Growth Length	P-value	Growth Ti	Growth Tf	Weight Growth Rate (mg/day)	Mean Weight Growth Rate	St Dev Weight Growth Rate	P-value
96382535	Tank 29	1	40	39	-1	-0.1	0.4	0.000	8.6	8.7	0.004	-0.001	0.007	0.002
96382535	Tank 29	2	33	32	-1				5.1	5	-0.004			
96382535	Tank 29	3	30	30	0				3.3	3.5	0.007			
96382535	Tank 29	4	34	34	0				4.4	4.6	0.007			
96382535	Tank 29	5	34	34	0				5.5	5.6	0.004			
96382535	Tank 29	6	37	37	0				7.4	7.4	0.000			
96382535	Tank 29	7	31	31	0				4.5	4.8	0.011			
96382535	Tank 29	8	32	32	0				3.7	3.7	0.000			
96382535	Tank 29	9	38	38	0				7.1	7.1	0.000			
96382535	Tank 29	10	33	33	0				4.3	4.2	-0.004			
96382535	Tank 29	11	32	32	0				4.6	4.5	-0.004			
96382535	Tank 29	12	34	34	0				4.9	5.1	0.007			
96382535	Tank 29	13	41	41	0				9.3	8.7	-0.021			
96382535	Tank 29	14	33	32	-1				5.2	5.3	0.004			
96382535	Tank 29	15	34	34	0				5.2	5.3	0.004			
96382535	Tank 29	16	40	40	0				8.1	8.7	0.021			
96382535	Tank 29	17	32	32	0				5.2	5	-0.007			
96382535	Tank 29	18	34	34	0				5.3	5.5	0.007			
96382535	Tank 29	19	40	40	0				8.7	8.6	-0.004			
96382535	Tank 29	20	31	31	0				4	4.2	0.007			
96382535	Tank 33	1	45	45	0				11.3	11.4	0.004			
96382535	Tank 33	2	36	36	0				6.3	6.1	-0.007			
96382535	Tank 33	3	34	34	0				5.3	5.2	-0.004			
96382535	Tank 33	4	32	32	0				4.2	4.1	-0.004			
96382535	Tank 33	5	30	30	0				3.9	3.6	-0.011			
96382535	Tank 33	6	34	34	0				5.3	5.2	-0.004			
96382535	Tank 33	7	36	36	0				6	5.9	-0.004			
96382535	Tank 33	8	37	37	0				7.7	7.6	-0.004			
96382535	Tank 33	9	35	36	1				7.2	7.1	-0.004			
96382535	Tank 33	10	35	35	0				5.2	5.3	0.004			
96382535	Tank 33	11	42	42	0				11.1	11.3	0.007			
96382535	Tank 33	12	34	34	0				5.4	5.3	-0.004			
96382535	Tank 33	13	34	34	0				4.8	4.6	-0.007			
96382535	Tank 33	14	44	45	1				10.6	10.6	0.000			
96382535	Tank 33	15	31	30	-1				4	3.9	-0.004			
96382535	Tank 33	16	37	37	0				7.3	7.3	0.000			
96382535	Tank 33	17	32	32	0				4.2	4.4	0.007			
96382535	Tank 33	18	38	38	0				6.8	6.7	-0.004			
96382535	Tank 33	19	30	30	0				3.3	3.2	-0.004			
96382535	Tank 33	20	36	36	0				5.9	5.8	-0.004			

Ti = Time Initial
Tf = Time Final
* = Dead

Station	Lab ID	Rep	Length Ti	Length Tf	Net Growth (mm)	Mean Net Growth Length	St Dev Net Growth Length	P-value	Growth Ti	Growth Tf	Weight Growth Rate (mg/day)	Mean Weight Growth Rate	St Dev Weight Growth Rate	P-value
96382535	Tank 36	1	32	32	0				4.2	4.2	0.000			
96382535	Tank 36	2	38	38	0				7	7	0.000			
96382535	Tank 36	3	39	39	0				7.8	7.8	0.000			
96382535	Tank 36	4	31	31	0				4.2	4.1	-0.004			
96382535	Tank 36	5	32	32	0				4.5	4.4	-0.004			
96382535	Tank 36	6	36	36	0				5.7	5.6	-0.004			
96382535	Tank 36	7	29	29	0				3.8	3.7	-0.004			
96382535	Tank 36	8	39	38	-1				7.2	7.1	-0.004			
96382535	Tank 36	9	32	32	0				4	3.8	-0.007			
96382535	Tank 36	10	32	32	0				4.3	4.4	0.004			
96382535	Tank 36	11	31	31	0				4.3	4.4	0.004			
96382535	Tank 36	12	43	42	-1				8.6	8.1	-0.018			
96382535	Tank 36	13	31	30	-1				4.3	4.2	-0.004			
96382535	Tank 36	14	37	37	0				7.2	7.1	-0.004			
96382535	Tank 36	15	42	42	0				10	10.1	0.004			
96382535	Tank 36	16	37	37	0				6.8	7	0.007			
96382535	Tank 36	17	31	31	0				4.2	4	-0.007			
96382535	Tank 36	18	31	31	0				3.8	3.9	0.004			
96382535	Tank 36	19	33	33	0				4.6	4.5	-0.004			
96382535	Tank 36	20	32	32	0				4.3	4.3	0.000			
96382537	Tank 1	1	37	40	3	0.3	0.7	0.102	9.2	9.1	-0.004	-0.001	0.006	0.004
96382537	Tank 1	2	43	43	0				10.5	10.3	-0.007			
96382537	Tank 1	3	40	40	0				8.7	8.8	0.004			
96382537	Tank 1	4	41	41	0				9.7	9.2	-0.018			
96382537	Tank 1	5	36	37	1				5.3	5.3	0.000			
96382537	Tank 1	6	30	30	0				3.6	3.6	0.000			
96382537	Tank 1	7	42	43	1				11.9	11.7	-0.007			
96382537	Tank 1	8	36	37	1				6.6	6.3	-0.011			
96382537	Tank 1	9	43	*					9.8	*				
96382537	Tank 1	10	39	40	1				8	8	0.000			
96382537	Tank 1	11	43	43	0				8.7	9.3	0.021			
96382537	Tank 1	12	37	37	0				5.5	5.5	0.000			
96382537	Tank 1	13	34	34	0				5.5	5.6	0.004			
96382537	Tank 1	14	42	43	1				12.2	12.1	-0.004			
96382537	Tank 1	15	37	37	0				6.2	6.4	0.007			
96382537	Tank 1	16	33	33	0				5.6	5.7	0.004			
96382537	Tank 1	17	36	37	1				6.4	6.5	0.004			
96382537	Tank 1	18	39	39	0				7.8	7.7	-0.004			
96382537	Tank 1	19	45	45	0				13.7	13.9	0.007			
96382537	Tank 1	20	37	37	0				6.9	7.1	0.007			

Ti = Time Initial
Tf = Time Final
* = Dead clam

Station	Lab ID	Rep	Length Ti	Length Tf	Net Growth (mm)	Mean Net Growth Length	St Dev Net Growth Length	P-value	Growth Ti	Growth Tf	Weight Growth Rate (mg/day)	Mean Weight Growth Rate	St Dev Weight Growth Rate	P-value
96382537	Tank 10	1	35	36	1				5.9	5.9	0.000			
96382537	Tank 10	2	36	37	1				6	5.8	-0.007			
96382537	Tank 10	3	38	40	2				7.7	7.7	0.000			
96382537	Tank 10	4	40	40	0				8.1	8.1	0.000			
96382537	Tank 10	5	35	35	0				5.1	4.8	-0.011			
96382537	Tank 10	6	42	42	0				10.2	10.1	-0.004			
96382537	Tank 10	7	35	35	0				5.2	5.2	0.000			
96382537	Tank 10	8	31	31	0				4.1	4	-0.004			
96382537	Tank 10	9	34	34	0				5	5	0.000			
96382537	Tank 10	10	34	34	0				4.9	4.9	0.000			
96382537	Tank 10	11	34	34	0				4.8	4.9	0.004			
96382537	Tank 10	12	42	42	0				9.3	9.1	-0.007			
96382537	Tank 10	13	42	42	0				11.3	11.5	0.007			
96382537	Tank 10	14	42	42	0				10.2	10	-0.007			
96382537	Tank 10	15	45	45	0				11.2	11.1	-0.004			
96382537	Tank 10	16	39	40	1				8.4	8.1	-0.011			
96382537	Tank 10	17	40	41	1				9	9	0.000			
96382537	Tank 10	18	38	39	1				7.9	7.8	-0.004			
96382537	Tank 10	19	32	33	1				4.5	4.5	0.000			
96382537	Tank 10	20	35	36	1				6.3	6.4	0.004			
96382537	Tank 35	1	41	41	0				10.1	10.1	0.000			
96382537	Tank 35	2	35	36	1				5.8	6.1	0.011			
96382537	Tank 35	3	36	36	0				6.1	6.4	0.011			
96382537	Tank 35	4	42	42	0				11.4	11.2	-0.007			
96382537	Tank 35	5	36	36	0				5.5	5.5	0.000			
96382537	Tank 35	6	35	37	2				5.4	5.4	0.000			
96382537	Tank 35	7	36	36	0				6.4	6.4	0.000			
96382537	Tank 35	8	35	35	0				5.7	5.6	-0.004			
96382537	Tank 35	9	34	34	0				5.9	5.8	-0.004			
96382537	Tank 35	10	35	35	0				6.2	6.1	-0.004			
96382537	Tank 35	11	31	31	0				4.2	4	-0.007			
96382537	Tank 35	12	38	38	0				8.3	8.3	0.000			
96382537	Tank 35	13	35	35	0				5.7	5.6	-0.004			
96382537	Tank 35	14	30	30	0				4.5	4.4	-0.004			
96382537	Tank 35	15	36	35	-1				6	5.9	-0.004			
96382537	Tank 35	16	32	32	0				4.6	4.6	0.000			
96382537	Tank 35	17	33	33	0				5.3	5.1	-0.007			
96382537	Tank 35	18	42	42	0				9.4	9.2	-0.007			
96382537	Tank 35	19	34	34	0				4.6	4.7	0.004			
96382537	Tank 35	20	41	41	0				9.4	9.3	-0.004			

Ti = Time Initial
Tf = Tim~~Final
* = Dea[illegible]n

Station	Lab ID	Rep	Length Ti	Length Tf	Net Growth (mm)	Mean Net Growth Length	St Dev Net Growth Length	P-value	Growth Ti	Growth Tf	Weight Growth Rate (mg/day)	Mean Weight Growth Rate	St Dev Weight Growth Rate	P-value
96382541	Tank 3	1	34	35	1	0.1	0.4	0.118	5.5	5.6	0.004	0.000	0.006	0.001
96382541	Tank 3	2	36	36	0				6.2	6.8	0.021			
96382541	Tank 3	3	40	40	0				8.3	8.2	-0.004			
96382541	Tank 3	4	37	37	0				5.8	5.8	0.000			
96382541	Tank 3	5	41	42	1				9	9	0.000			
96382541	Tank 3	6	35	36	1				5.6	5.6	0.000			
96382541	Tank 3	7	34	34	0				4.4	4.5	0.004			
96382541	Tank 3	8	31	31	0				5	4.9	-0.004			
96382541	Tank 3	9	43	43	0				11.7	12	0.011			
96382541	Tank 3	10	35	35	0				5.8	5.9	0.004			
96382541	Tank 3	11	33	33	0				4.5	4.7	0.007			
96382541	Tank 3	12	35	35	0				5.8	5.7	-0.004			
96382541	Tank 3	13	42	41	-1				9	9.1	0.004			
96382541	Tank 3	14	33	33	0				4.5	4.4	-0.004			
96382541	Tank 3	15	28	29	1				3.7	3.5	-0.007			
96382541	Tank 3	16	32	32	0				4.7	4.7	0.000			
96382541	Tank 3	17	30	30	0				4.5	4.3	-0.007			
96382541	Tank 3	18	37	38	1				7.5	7.3	-0.007			
96382541	Tank 3	19	36	36	0				6.7	6.8	0.004			
96382541	Tank 3	20	42	42	0				11.5	11.7	0.007			
96382541	Tank 19	1	43	43	0				9.7	9.4	-0.011			
96382541	Tank 19	2	42	42	0				11.1	11.2	0.004			
96382541	Tank 19	3	38	40	2				8.1	8.2	0.004			
96382541	Tank 19	4	35	35	0				5.8	5.5	-0.011			
96382541	Tank 19	5	42	43	1				10.3	10.5	0.007			
96382541	Tank 19	6	35	35	0				6.2	6.1	-0.004			
96382541	Tank 19	7	36	36	0				5.2	5.1	-0.004			
96382541	Tank 19	8	39	*					5.2*	4.4*				
96382541	Tank 19	9	35	35	0				5.5	5.4	-0.004			
96382541	Tank 19	10	33	33	0				5.9	5.7	-0.007			
96382541	Tank 19	11	32	32	0				4.9	4.8	-0.004			
96382541	Tank 19	12	36	36	0				5.4	5.4	0.000			
96382541	Tank 19	13	34	34	0				5.7	5.7	0.000			
96382541	Tank 19	14	35	35	0				5.6	5.5	-0.004			
96382541	Tank 19	15	36	36	0				5.9	5.7	-0.007			
96382541	Tank 19	16	32	31	-1				4.5	4.4	-0.004			
96382541	Tank 19	17	32	32	0				4.6	4.5	-0.004			
96382541	Tank 19	18	43	43	0				10.2	10.2	0.000			
96382541	Tank 19	19	34	34	0				4.6	4.6	0.000			
96382541	Tank 19	20	39	39	0				8.5	8.7	0.007			

Ti = Time Initial
Tf = Time Final
* = Dead clam

Station	Lab ID	Rep	Length Ti	Length Tf	Net Growth (mm)	Mean Net Growth Length	St Dev Net Growth Length	P-value	Growth Ti	Growth Tf	Weight Growth Rate (mg/day)	Mean Weight Growth Rate	St Dev Weight Growth Rate	P-value
96382541	Tank 21	1	32	32	0				4.3	4.4	0.004			
96382541	Tank 21	2	38	38	0				6.7	6.4	-0.011			
96382541	Tank 21	3	29	29	0				3.3	3.2	-0.004			
96382541	Tank 21	4	36	36	0				6.4	6.3	-0.004			
96382541	Tank 21	5	30	30	0				4	3.9	-0.004			
96382541	Tank 21	6	30	30	0				3.7	3.6	-0.004			
96382541	Tank 21	7	33	33	0				5.4	5.2	-0.007			
96382541	Tank 21	8	34	34	0				5.1	5.2	0.004			
96382541	Tank 21	9	41	41	0				10.2	10.1	-0.004			
96382541	Tank 21	10	38	38	0				7.7	7.6	-0.004			
96382541	Tank 21	11	36	36	0				5.3	5.4	0.004			
96382541	Tank 21	12	35	35	0				4.9	4.9	0.000			
96382541	Tank 21	13	34	34	0				4.2	4.4	0.007			
96382541	Tank 21	14	32	32	0				3.9	4	0.004			
96382541	Tank 21	15	38	38	0				6.4	6.4	0.000			
96382541	Tank 21	16	31	31	0				3.5	3.5	0.000			
96382541	Tank 21	17	39	39	0				7.4	7.5	0.004			
96382541	Tank 21	18	43	43	0				10.6	10.6	0.000			
96382541	Tank 21	19	33	33	0				4.1	4.2	0.004			
96382541	Tank 21	20	34	34	0				5.4	5.3	-0.004			
96382543	Tank 5	1	35	35	0	0.2	0.6	0.308	5.9	6	0.004	-0.002	0.007	0.039
96382543	Tank 5	2	32	32	0				4.7	4.8	0.004			
96382543	Tank 5	3	35	36	1				6.1	6.4	0.011			
96382543	Tank 5	4	36	36	0				6.1	6.3	0.007			
96382543	Tank 5	5	33	33	0				5.1	4.9	-0.007			
96382543	Tank 5	6	36	36	0				5.6	5.5	-0.004			
96382543	Tank 5	7	34	35	1				5.1	5.2	0.004			
96382543	Tank 5	8	38	38	0				6.9	7	0.004			
96382543	Tank 5	9	37	37	0				6.4	6.5	0.004			
96382543	Tank 5	10	38	38	0				6.9	6.9	0.000			
96382543	Tank 5	11	41	40	-1				7.8	7.8	0.000			
96382543	Tank 5	12	35	35	0				5.3	5.1	-0.007			
96382543	Tank 5	13	34	34	0				5.8	6	0.007			
96382543	Tank 5	14	33	34	1				5.8	5.9	0.004			
96382543	Tank 5	15	31	31	0				4.2	4	-0.007			
96382543	Tank 5	16	29	29	0				3.4	3.3	-0.004			
96382543	Tank 5	17	34	34	0				4.4	4.2	-0.007			
96382543	Tank 5	18	38	37	-1				6.7	6.4	-0.011			
96382543	Tank 5	19	40	39	-1				9	9	0.000			
96382543	Tank 5	20	38	38	0				8.4	8.2	-0.007			

Ti = Time Initial
Tf = Time Final
* = Dea n

Station	Lab ID	Rep	Length Ti	Length Tf	Net Growth (mm)	Mean Net Growth Length	St Dev Net Growth Length	P-value	Growth Ti	Growth Tf	Weight Growth Rate (mg/day)	Mean Weight Growth Rate	St Dev Weight Growth Rate	P-value
96382543	Tank 27	1	41	41	0				10.1	10.1	0.000			
96382543	Tank 27	2	31	32	1				4.7	4.7	0.000			
96382543	Tank 27	3	36	37	1				6.5	6.1	-0.014			
96382543	Tank 27	4	34	34	0				5.7	5.4	-0.011			
96382543	Tank 27	5	33	33	0				4.6	4.3	-0.011			
96382543	Tank 27	6	34	33	-1				5.2	4.9	-0.011			
96382543	Tank 27	7	35	35.	0				5.5	5.2	-0.011			
96382543	Tank 27	8	37	36	-1				8	7.6	-0.014			
96382543	Tank 27	9	45	*					15	*				
96382543	Tank 27	10	32	32	0				4.7	4.3	-0.014			
96382543	Tank 27	11	39	40	1				7.5	7.1	-0.014			
96382543	Tank 27	12	34	35	1				5.3	5.5	0.007			
96382543	Tank 27	13	34	34	0				5.1	5.1	0.000			
96382543	Tank 27	14	40	40	0				8.5	8.7	0.007			
96382543	Tank 27	15	36	36	0				5.9	6.1	0.007			
96382543	Tank 27	16	31	31	0				4	4	0.000			
96382543	Tank 27	17	31	31	0				4.3	4.3	0.000			
96382543	Tank 27	18	31	31	0				4.5	4.4	-0.004			
96382543	Tank 27	19	33	33	0				5.8	5.5	-0.011			
96382543	Tank 27	20	31	32	1				4.3	4.1	-0.007			
96382543	Tank 30	1	34	35	1				5.9	6.1	0.007			
96382543	Tank 30	2	34	35	1				5.7	5.5	-0.007			
96382543	Tank 30	3	31	32	1				4.5	4.4	-0.004			
96382543	Tank 30	4	33	33	0				4.9	4.8	-0.004			
96382543	Tank 30	5	36	36	0				5.5	5.6	0.004			
96382543	Tank 30	6	35	36	1				5.7	5.6	-0.004			
96382543	Tank 30	7	34	34	0				5.6	5.6	0.000			
96382543	Tank 30	8	31	32	1				4.5	4.8	0.011			
96382543	Tank 30	9	32	32	0				4.6	4.5	-0.004			
96382543	Tank 30	10	33	33	0				4.6	4.7	0.004			
96382543	Tank 30	11	39	39	0				9.4	9.1	-0.011			
96382543	Tank 30	12	32	31	-1				4.1	3.9	-0.007			
96382543	Tank 30	13	38	39	1				7.2	7.1	-0.004			
96382543	Tank 30	14	39	40	1				8.6	8.8	0.007			
96382543	Tank 30	15	33	33	0				4.4	4.4	0.000			
96382543	Tank 30	16	34	34	0				6	6.1	0.004			
96382543	Tank 30	17	34	35	1				5.3	5.1	-0.007			
96382543	Tank 30	18	34	34	0				5.1	4.9	-0.007			
96382543	Tank 30	19	37	36	-1				5.6	5.6	0.000			
96382543	Tank 30	20	32	32	0				4.5	4.4	-0.004			

Ti = Time Initial
Tf = Time Final
* = Dead clam

Station	Lab ID	Rep	Length Ti	Length Tf	Net Growth (mm)	Mean Net Growth Length	St Dev Net Growth Length	P-value	Growth Ti	Growth Tf	Weight Growth Rate (mg/day)	Mean Weight Growth Rate	St Dev Weight Growth Rate	P-value
96382545	Tank 7	1	43	43	0	0.1	0.5	0.121	11.7	12	0.011	0.001	0.008	0.000
96382545	Tank 7	2	41	42	1				9.3	9.4	0.004			
96382545	Tank 7	3	35	35	0				5.2	5.4	0.007			
96382545	Tank 7	4	35	34	-1				4.9	5	0.004			
96382545	Tank 7	5	32	32	0				4.1	4.1	0.000			
96382545	Tank 7	6	35	35	0				5.7	5.7	0.000			
96382545	Tank 7	7	33	33	0				4.6	4.5	-0.004			
96382545	Tank 7	8	30	30	0				4.6	5.6	0.036			
96382545	Tank 7	9	39	39	0				7.6	8.4	0.029			
96382545	Tank 7	10	35	35	0				5.1	5.2	0.004			
96382545	Tank 7	11	30	30	0				3.8	3.7	-0.004			
96382545	Tank 7	12	35	35	0				5.1	5.1	0.000			
96382545	Tank 7	13	29	29	0				3.6	3.5	-0.004			
96382545	Tank 7	14	37	37	0				7.1	7.1	0.000			
96382545	Tank 7	15	40	40	0				9.1	9.1	0.000			
96382545	Tank 7	16	29	29	0				3.4	3.3	-0.004			
96382545	Tank 7	17	39	39	0				9.5	9.1	-0.014			
96382545	Tank 7	18	38	38	0				7.8	7.9	0.004			
96382545	Tank 7	19	40	40	0				9.6	9.8	0.007			
96382545	Tank 7	20	37	37	0				6.3	6.3	0.000			
96382545	Tank 11	1	34	35	1				5.4	5.3	-0.004			
96382545	Tank 11	2	43	44	1				12.1	12.1	0.000			
96382545	Tank 11	3	41	42	1				9.9	9.6	-0.011			
96382545	Tank 11	4	33	34	1				5.2	5.2	0.000			
96382545	Tank 11	5	43	43	0				11	11	0.000			
96382545	Tank 11	6	41	41	0				9.9	9.7	-0.007			
96382545	Tank 11	7	31	31	0				3.9	4	0.004			
96382545	Tank 11	8	37	37	0				8	8.1	0.004			
96382545	Tank 11	9	41	42	1				9.4	9.7	0.011			
96382545	Tank 11	10	42	42	0				10.9	11.4	0.018			
96382545	Tank 11	11	40	40	0				9.7	9.5	-0.007			
96382545	Tank 11	12	43	43	0				11.1	10.9	-0.007			
96382545	Tank 11	13	33	34	1				5.7	5.9	0.007			
96382545	Tank 11	14	34	35	1				5.4	5.7	0.011			
96382545	Tank 11	15	31	31	0				3.8	3.9	0.004			
96382545	Tank 11	16	34	34	0				4.7	4.7	0.000			
96382545	Tank 11	17	44	44	0				11.7	11.6	-0.004			
96382545	Tank 11	18	34	34	0				4.9	4.8	-0.004			
96382545	Tank 11	19	34	34	0				4	4.1	0.004			
96382545	Tank 11	20	31	32	1				4.1	4.2	0.004			

Ti = Time Initial
Tf = Time Final
* = Dead

Station	Lab ID	Rep	Length Ti	Length Tf	Net Growth (mm)	Mean Net Growth Length	St Dev Net Growth Length	P-value	Growth Ti	Growth Tf	Weight Growth Rate (mg/day)	Mean Weight Growth Rate	St Dev Weight Growth Rate	P-value
96382545	Tank 17	1	35	35	0				6	6.3	0.011			
96382545	Tank 17	2	31	31	0				3.6	3.6	0.000			
96382545	Tank 17	3	29	29	0				3.5	3.5	0.000			
96382545	Tank 17	4	36	36	0				6.3	6.3	0.000			
96382545	Tank 17	5	32	32	0				4.5	4.6	0.004			
96382545	Tank 17	6	32	31	-1				3.6	3.7	0.004			
96382545	Tank 17	7	38	38	0				6.8	7	0.007			
96382545	Tank 17	8	37	37	0				6.6	6.4	-0.007			
96382545	Tank 17	9	32	32	0				3.8	3.8	0.000			
96382545	Tank 17	10	32	32	0				4.4	4.3	-0.004			
96382545	Tank 17	11	29	29	0				3.9	3.8	-0.004			
96382545	Tank 17	12	37	38	1				7.1	7	-0.004			
96382545	Tank 17	13	30	30	0				4.2	4.1	-0.004			
96382545	Tank 17	14	32	32	0				3.8	3.7	-0.004			
96382545	Tank 17	15	37	36	-1				6.2	5.9	-0.011			
96382545	Tank 17	16	38	38	0				6.9	6.7	-0.007			
96382545	Tank 17	17	30	30	0				3.3	3.3	0.000			
96382545	Tank 17	18	35	34	-1				4.8	4.8	0.000			
96382545	Tank 17	19	32	32	0				4.4	4.4	0.000			
96382545	Tank 17	20	39	39	0				7.2	6.9	-0.011			
96382546	Tank 13	1	32	32	0	0.1	0.4	0.029	4.8	5.1	0.011	0.000	0.010	0.004
96382546	Tank 13	2	31	31	0				4.6	4.6	0.000			
96382546	Tank 13	3	33	33	0				4.5	4.8	0.011			
96382546	Tank 13	4	33	32	-1				4.8	5	0.007			
96382546	Tank 13	5	35	35	0				4.9	5.2	0.011			
96382546	Tank 13	6	35	35	0				5.3	5.3	0.000			
96382546	Tank 13	7	33	33	0				4.8	4.7	-0.004			
96382546	Tank 13	8	36	37	1				4.3	4.2	-0.004			
96382546	Tank 13	9	37	37	0				7.5	7.3	-0.007			
96382546	Tank 13	10	33	33	0				4.4	4.4	0.000			
96382546	Tank 13	11	32	33	1				4.6	4.7	0.004			
96382546	Tank 13	12	43	43	0				10.5	10.7	0.007			
96382546	Tank 13	13	34	34	0				4.8	4.8	0.000			
96382546	Tank 13	14	31	32	1				4.1	4.1	0.000			
96382546	Tank 13	15	36	36	0				3.1	4.8	0.061			
96382546	Tank 13	16	39	39	0				7.8	7.8	0.000			
96382546	Tank 13	17	36	37	1				6.2	6.2	0.000			
96382546	Tank 13	18	31	31	0				3.8	3.8	0.000			
96382546	Tank 13	19	31	31	0				4.1	4	-0.004			
96382546	Tank 13	20	30	30	0				3.9	3.9	0.000			

Ti = Time Initial
Tf = Time Final
* = Dead clam

Station	Lab ID	Rep	Length Ti	Length Tf	Net Growth (mm)	Mean Net Growth Length	St Dev Net Growth Length	P-value	Growth Ti	Growth Tf	Weight Growth Rate (mg/day)	Mean Weight Growth Rate	St Dev Weight Growth Rate	P-value
96382546	Tank 18	1	32	32	0				4.3	4.7	0.014			
96382546	Tank 18	2	29	29	0				3.5	3.4	-0.004			
96382546	Tank 18	3	40	40	0				8.2	8	-0.007			
96382546	Tank 18	4	40	39	-1				7.1	7.3	0.007			
96382546	Tank 18	5	37	37	0				7.6	7.4	-0.007			
96382546	Tank 18	6	31	31	0				4.4	4.5	0.004			
96382546	Tank 18	7	35	35	0				5.3	5.2	-0.004			
96382546	Tank 18	8	44	44	0				12.3	12	-0.011			
96382546	Tank 18	9	37	37	0				5.9	5.8	-0.004			
96382546	Tank 18	10	30	30	0				3.2	3.2	0.000			
96382546	Tank 18	11	41	41	0				11.7	11.7	0.000			
96382546	Tank 18	12	36	36	0				6.4	6.4	0.000			
96382546	Tank 18	13	34	34	0				4.7	4.4	-0.011			
96382546	Tank 18	14	43	43	0				10.9	10.7	-0.007			
96382546	Tank 18	15	39	39	0				9.7	9.6	-0.004			
96382546	Tank 18	16	38	38	0				9.4	9.3	-0.004			
96382546	Tank 18	17	39	39	0				7.1	7.2	0.004			
96382546	Tank 18	18	29	29	0				3.5	3.5	0.000			
96382546	Tank 18	19	40	40	0				9	8.9	-0.004			
96382546	Tank 18	20	31	31	0				3.8	3.7	-0.004			
96382546	Tank 25	1	33	33	0				5.5	5.4	-0.004			
96382546	Tank 25	2	35	36	1				5.2	5.2	0.000			
96382546	Tank 25	3	33	34	1				4.7	4.6	-0.004			
96382546	Tank 25	4	40	40	0				7.5	7.2	-0.011			
96382546	Tank 25	5	31	31	0				3.9	3.7	-0.007			
96382546	Tank 25	6	38	38	0				7.9	7.8	-0.004			
96382546	Tank 25	7	40	40	0				8	8.1	0.004			
96382546	Tank 25	8	39	39	0				8.5	8.6	0.004			
96382546	Tank 25	9	34	33	-1				4.6	3.9	-0.025			
96382546	Tank 25	10	34	34	0				5.3	5.2	-0.004			
96382546	Tank 25	11	29	29	0				3.1	3.1	0.000			
96382546	Tank 25	12	34	34	0				5.3	5.2	-0.004			
96382546	Tank 25	13	39	39	0				7.1	6.9	-0.007			
96382546	Tank 25	14	40	40	0				8.7	8.6	-0.004			
96382546	Tank 25	15	37	37	0				6.6	6.6	0.000			
96382546	Tank 25	16	33	33	0				4.9	4.8	-0.004			
96382546	Tank 25	17	34	34	0				4.5	4.9	0.014			
96382546	Tank 25	18	39	39	0				7.8	7.8	0.000			
96382546	Tank 25	19	37	37	0				8.5	8.5	0.000			
96382546	Tank 25	20	30	30	0				3.6	3.4	-0.007			

Ti = Time Initial
Tf = Time Final
• = Dead

ATTACHMENT K.7

FISH TISSUE DATA

MSU Whole Body

PSR MSU Fish Whole Body Tissue Analytical Results (Wet-Weight)

Constituent / Station ID: / Sample ID:	FT2-N-ES-W FT2-NORTH-ES-WB-R1	FT2-N-ES-W FT2-NORTH-ES-WB-R2	FT2-N-ES-W FT2-NORTH-ES-WB-R3	FT2-W-ES-W FT2-WEST-ES-WB-R2	FT2-W-ES-W FT2-WEST-ES-WB-R4	FT2-W-ES-W FT2-WEST-ES-WB-R5
Pesticides/PCBs (ug/kg)						
Aroclor 1016	14.00 U	13.00 U	13.00 UJ	13.00 U	13.00 U	14.00 UJ
Aroclor 1221	14.00 U	13.00 U	13.00 UJ	13.00 U	13.00 U	14.00 UJ
Aroclor 1232	14.00 U	13.00 U	13.00 UJ	13.00 U	13.00 U	14.00 UJ
Aroclor 1242	19.00	16.00	13.00 UJ	13.00 U	22.00	16.00 J
Aroclor 1248	14.00 U	13.00 U	13.00 UJ	13.00 U	13.00 U	14.00 UJ
Aroclor 1254	100.00	100.00	57.00 J	53.00	120.00	79.00 J
Aroclor 1260	170.00	100.00	62.00 J	74.00	160.00	110.00
Total PCB	289.00 T	216.00 T	119.00 T	127.00 T	302.00 T	205.00 T
Pesticides/PCBs - LLIPN (ug/kg)						
Total PCB	13136.36 T	6545.45 T	4407.40 T	6047.61 T	7550.00 T	5694.44 T
Dioxins and Furans (ng/kg)						
2378-TCDF	1.20	0.30 UI	0.30 UI	28.00	0.30 UE	0.88
Total TCDF	2.90	0.95	3.20	43.00	2.60	6.20
2378-TCDD	0.30 U	0.30 U	0.30 U	0.30 U	0.30 U	0.30 U
Total TCDD	0.30 U	0.30 U	0.94	0.30 U	0.30 U	0.58
12378-PeCDF	1.30 UE	1.30 UE	1.30 UE	1.30 UE	1.30 UE	1.30 UE
23478-PeCDF	1.30 U	1.30 U	1.30 UE	1.30 U	1.30 U	1.30 UE
Total PeCDF	1.30 U	1.30 U	1.30 U	1.30 U	3.30	1.30 U
12378-PeCDD	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
Total PeCDD	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
123478-HxCDF	1.30 UE	1.30 UE	1.30 UE	1.30 UE	1.30 UE	1.30 UE
123678-HxCDF	1.30 U	1.30 U	1.30 U	2.10	3.70	1.30 U
234678-HxCDF	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
123789-HxCDF	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
Total HxCDF	1.30 U	2.50	1.30 U	2.10	7.50	4.20
123478-HxCDD	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U

Blank cells indicate no analysis were performed.

PSR MSU Fish Whole Body Tissue Analytical Results (Wet-Weight)

Constituent	Station ID: / Sample ID:	FT2-N-ES-W / FT2-NORTH-ES-WB-R1	FT2-N-ES-W / FT2-NORTH-ES-WB-R2	FT2-N-ES-W / FT2-NORTH-ES-WB-R3	FT2-W-ES-W / FT2-WEST-ES-WB-R2	FT2-W-ES-W / FT2-WEST-ES-WB-R4	FT2-W-ES-W / FT2-WEST-ES-WB-R5
123678-HxCDD		1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
123789-HxCDD		1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
Total HxCDD		1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
1234678-HpCDF		1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
1234789-HpCDF		1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
Total HpCDF		1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
1234678-HpCDD		1.30 UI	2.90	2.20	2.50	8.70	1.70
Total HpCDD		1.30 U	4.80	2.20	2.50	17.00	3.10
OCDF		2.70 U	2.50 U	2.70 U	2.70 UI	2.60 U	2.60 U
OCDD		5.30 U	19.00	6.40 U	2.70 UI	200.00	15.00
Total 2,3,7,8-TCDD(Equiv)		0.12 T	0.04 T	0.02 T	3.03 T	0.65 T	0.12 T
Dioxins and Furans - LIPN (ng/kg)							
Total 2,3,7,8-TCDD(Equiv)		5.45 T	1.45 T	0.81 T	144.52 T	16.42 T	3.33 T
Inorganics (Total) (mg/kg)							
Mercury		0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
Conventional Parameters							
Lipids (%)		2.20	3.30	2.70	2.10	4.00	3.60

Blank cells indicate no analysis were performed.

Elliott Bay Background Whole Body

PSR Elliott Bay Background Fish Whole Body Tissue Analytical Results (Wet-Weight)

Constituent (Station ID: / Sample ID:)	FT2-A-ES-W FT2-ALKI-ES-WB-R1	FT2-A-ES-W FT2-ALKI-ES-WB-R2	FT2-A-ES-W FT2-ALKI-ES-WB-R3	FT2-M-ES-W FT2-MAGL-ES-WB-R1	FT2-M-ES-W FT2-MAGL-ES-WB-R2	FT2-M-ES-W FT2-MAGL-ES-WB-R3
Pesticides/PCBs (ug/kg)						
Aroclor 1016	11.00 U	13.00 U	11.00 U	12.00 UJ	13.00 U	14.00 U
Aroclor 1221	11.00 U	13.00 U	11.00 U	12.00 UJ	13.00 U	14.00 U
Aroclor 1232	11.00 U	13.00 U	11.00 U	12.00 UJ	13.00 U	14.00 U
Aroclor 1242	11.00 U	13.00 U	15.00	12.00 UJ	13.00 U	14.00 U
Aroclor 1248	11.00 U	13.00 U	11.00 U	12.00 UJ	13.00 U	14.00 U
Aroclor 1254	21.00 U	13.00 UJ	93.00	13.00 J	29.00	65.00
Aroclor 1260	32.00	31.00 J	89.00	40.00 J	52.00	100.00
Total PCB	32.00 T	31.00 T	197.00 T	53.00 T	81.00 T	165.00 T
Pesticides/PCBs - LLIPN (ug/kg)						
Total PCB	1185.18 T	1148.14 T	12312.50 T	1827.58 T	3240.00 T	5322.58 T
Dioxins and Furans (ng/kg)						
2378-TCDF	0.91	0.96	0.67	0.26 UI	1.50	0.30 UI
Total TCDF	0.91	0.96	0.67	0.46	3.00	1.40
2378-TCDD	0.26 U	0.25 U	0.26 U	0.26 U	0.30 U	0.30 U
Total TCDD	0.26 U	0.25 U	0.26 U	0.39	0.30 U	0.30 U
12378-PeCDF	1.30 UE	1.30 UE	1.30 UE	1.30 UE	1.30 U	1.30 UE
23478-PeCDF	1.30 U	1.30 U	1.30 UE	1.30 UI	1.30 U	1.30 U
Total PeCDF	1.30 U	1.30 U	1.30 U	1:40	1.30 U	3.50
12378-PeCDD	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
Total PeCDD	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
123478-HxCDF	1.30 UE	1.30 UE	1.30 UE	1.30 UE	1.30 U	1.30 UE
123678-HxCDF	1.30 U	1.30 U	1.30 U	1.30 UE	1.30 U	1.30 U
234678-HxCDF	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
123789-HxCDF	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
Total HxCDF	1.30 U	1.30 U	1.30 U	1.30 U	2.80	1.30 U
123478-HxCDD	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U

Blank cells indicate no analysis were performed.

PSR Elliott Bay Background Fish Whole Body Tissue Analytical Results (Wet-Weight)

Constituent	Station ID: / Sample ID:	FT2-A-ES-W FT2-ALKI-ES-WB-R1	FT2-A-ES-W FT2-ALKI-ES-WB-R2	FT2-A-ES-W FT2-ALKI-ES-WB-R3	FT2-M-ES-W FT2-MAGL-ES-WB-R1	FT2-M-ES-W FT2-MAGL-ES-WB-R2	FT2-M-ES-W FT2-MAGL-ES-WB-R3
123678-HxCDD		1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
123789-HxCDD		1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
Total HxCDD		1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
1234678-HpCDF		1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
1234789-HpCDF		1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
Total HpCDF		1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
1234678-HpCDD		1.30 U	9.00	1.30 U	1.30	1.30 U	8.40
Total HpCDD		1.30 U	14.00	1.30 U	1.30	1.30 U	13.00
OCDF		2.60 U	8.90	2.60 U	2.60 U	2.60 U	2.70 UI
OCDD		5.50 U	110.00	5.40 U	4.50 U	5.00 U	48.00
Total 2,3,7,8-TCDD(Equiv)		0.09 T	0.30 T	0.06 T	0.01 T	0.15 T	0.13 T
Dioxins and Furans - LIPN (ng/kg)							
Total 2,3,7,8-TCDD(Equiv)		3.37 T	11.29 T	4.18 T	0.44 T	6.00 T	4.25 T
Inorganics (Total) (mg/kg)							
Mercury		0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
Conventional Parameters							
Lipids (%)		2.70	2.70	1.60	2.90	2.50	3.10

Blank cells indicate no analysis were performed.

MSU Fillet

PSR MSU Fish Fillet Tissue Analytical Results (Wet-Weight)

Constituent Station ID: / Sample ID:	FT2-N-ES-F / FT2-NORTH-ES-FT-R1	FT2-N-ES-F / FT2-NORTH-ES-FT-R3	FT2-N-ES-R / FT2-NORTH-ES-FT-R2	FT2-W-ES-F / FT2-WEST-ES-FT-R1	FT2-W-ES-F / FT2-WEST-ES-FT-R3	FT2-W-ES-F / FT2-WEST-ES-FT-R4
Pesticides/PCBs (ug/kg)						
Aroclor 1016	14.00 U	14.00 U	13.00 U	12.00 U	14.00 U	13.00 U
Aroclor 1221	14.00 U	14.00 U	13.00 U	12.00 U	14.00 U	13.00 U
Aroclor 1232	14.00 U	14.00 U	13.00 U	12.00 U	14.00 U	13.00 U
Aroclor 1242	25.00	52.00	13.00 U	13.00	14.00 U	13.00 U
Aroclor 1248	14.00 U	14.00 U	13.00 U	12.00 U	14.00 U	13.00 U
Aroclor 1254	330.00	300.00	64.00	140.00	60.00	54.00
Aroclor 1260	76.00	140.00	53.00	100.00	89.00	51.00
Total PCB	431.00 T	492.00 T	117.00 T	253.00 T	149.00 T	105.00 T
Pesticides/PCBs - LLIPN (ug/kg)						
Total PCB	23944.44 T	25894.73 T	8357.14 T	11000.00 T	9933.33 T	8750.00 T
Dioxins and Furans (ng/kg)						
2378-TCDF	0.26 UE	0.75				0.26 UE
Total TCDF	10.00	4.20				0.26 U
2378-TCDD	0.26 U	0.26 U				0.26 U
Total TCDD	0.26 U	0.85				0.26 U
12378-PeCDF	1.30 UE	1.30 UE				1.30 UE
23478-PeCDF	1.30 UE	1.30 U				1.30 U
Total PeCDF	8.30	1.90				1.30 U
12378-PeCDD	1.30 U	1.30 U				1.30 U
Total PeCDD	1.30 U	1.30 U				1.30 U
123478-HxCDF	1.30 UE	1.30 UE				1.30 UE
123678-HxCDF	2.50	1.30 UE				1.30 U
234678-HxCDF	1.30 U	1.30 U				1.30 U
123789-HxCDF	1.30 U	1.30 U				1.30 U
Total HxCDF	5.30	1.30 U				1.30 U
123478-HxCDD	1.30 U	1.30 U				1.30 U

Blank cells indicate no analysis were performed.

PSR MSU Fish Fillet Tissue Analytical Results (Wet-Weight)

Station ID:	FT2-N-ES-F	FT2-N-ES-F	FT2-N-ES-R	FT2-W-ES-F	FT2-W-ES-F	FT2-W-ES-F
Constituent — Sample ID:	FT2-NORTH-ES-FT-R1	FT2-NORTH-ES-FT-R3	FT2-NORTH-ES-FT-R2	FT2-WEST-ES-FT-R1	FT2-WEST-ES-FT-R3	FT2-WEST-ES-FT-R4
123678-HxCDD	1.30 U	1.30 U				1.30 U
123789-HxCDD	1.30 U	1.30 U				1.30 U
Total HxCDD	1.30 U	18.00				1.30 U
1234678-HpCDF	1.90	1.30 U				1.30 U
1234789-HpCDF	1.30 U	1.30 U				1.30 U
Total HpCDF	1.90	1.30 U				1.30 U
1234678-HpCDD	3.10	1.30 U				1.30 U
Total HpCDD	3.10	3.50				1.30 U
OCDF	5.60	2.60 U				2.60 U
OCDD	11.00	2.60 U				2.90 U
Total 2,3,7,8-TCDD(Equiv)	0.31 T	0.07 T				2.90 UT
Dioxins and Furans - LIPN (ng/kg)						
Total 2,3,7,8-TCDD(Equiv)	17.58 T	3.94 T				2.90 UT
Inorganics (Total) (mg/kg)						
Mercury	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
Conventional Parameters						
Lipids (%)	1.80	1.90	1.40	2.30	1.50	1.20

Blank cells indicate no analysis were performed.

Elliott Bay Background Fillet

PSR Elliott Bay Background Fish Fillet Tissue Analytical Results (Wet-Weight)

Station ID:	FT2-A-ES-F	FT2-A-ES-F	FT2-A-ES-F	FT2-M-ES-F	FT2-M-ES-F	FT2-M-ES-F
Constituent Sample ID:	FT2-ALKI-ES-FT-R1	FT2-ALKI-ES-FT-R2	FT2-ALKI-ES-FT-R3	FT2-MAGL-ES-FT-R1	FT2-MAGL-ES-FT-R2	FT2-MAGL-ES-FT-R3
Pesticides/PCBs (ug/kg)						
Aroclor 1016	12.00 U	14.00 U	13.00 U	13.00 U	14.00 U	14.00 U
Aroclor 1221	12.00 U	14.00 U	13.00 U	13.00 U	14.00 U	14.00 U
Aroclor 1232	12.00 U	14.00 U	13.00 U	13.00 U	14.00 U	14.00 U
Aroclor 1242	12.00 U	14.00 U	13.00 U	13.00 U	14.00 U	14.00 U
Aroclor 1248	12.00 U	14.00 U	13.00 U	13.00 U	14.00 U	14.00 U
Aroclor 1254	17.00 U	19.00 U	13.00 U	34.00	18.00	15.00 U
Aroclor 1260	12.00 J	24.00	17.00	61.00	34.00	30.00
Total PCB	12.00 T	24.00 T	17.00 T	95.00 T	52.00 T	30.00 T
Pesticides/PCBs - LLIPN (ug/kg)						
Total PCB	1090.90 T	2727.27 T	2698.41 T	9500.00 T	6582.27 T	5769.23 T
Dioxins and Furans (ng/kg)						
2378-TCDF	0.30 UI	0.58	0.26 U	0.75	0.73	0.62
Total TCDF	0.35	0.58	0.26 U	0.75	0.73	2.20
2378-TCDD	0.30 U	0.25 U	0.26 U	0.26 U	0.30 U	0.26 U
Total TCDD	0.30 U	0.25 U	0.26 U	0.26 U	0.30 U	0.26 U
12378-PeCDF	1.30 UE	1.30 UE	1.30 UE	1.30 UE	1.30 U	1.30 UE
23478-PeCDF	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
Total PeCDF	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
12378-PeCDD	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
Total PeCDD	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
123478-HxCDF	1.30 UI	1.30 UE	1.30 UE	1.30 UE	1.30 UE	1.30 UE
123678-HxCDF	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
234678-HxCDF	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
123789-HxCDF	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
Total HxCDF	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
123478-HxCDD	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U

Blank cells indicate no analysis were performed.

PSR Elliott Bay Background Fish Fillet Tissue Analytical Results (Wet-Weight)

Constituent / Station ID: / Sample ID:	FT2-A-ES-F FT2-ALKI-ES-FT-R1	FT2-A-ES-F FT2-ALKI-ES-FT-R2	FT2-A-ES-F FT2-ALKI-ES-FT-R3	FT2-M-ES-F FT2-MAGL-ES-FT-R1	FT2-M-ES-F FT2-MAGL-ES-FT-R2	FT2-M-ES-F FT2-MAGL-ES-FT-R3
123678-HxCDD	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
123789-HxCDD	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
Total HxCDD	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
1234678-HpCDF	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
1234789-HpCDF	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
Total HpCDF	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
1234678-HpCDD	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
Total HpCDD	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U	1.30 U
OCDF	2.60 UI	2.50 U	2.60 U	2.60 U	2.60 U	2.60 U
OCDD	2.60 U	2.50 U	2.60 U	2.60 U	7.10 U	17.00
Total 2,3,7,8-TCDD(Equiv)	2.60 UT	0.05 T	2.60 UT	0.07 T	0.07 T	0.07 T
Dioxins and Furans - LIPN (ng/kg)						
Total 2,3,7,8-TCDD(Equiv)	2.60 UT	6.59 T	2.60 UT	7.50 T	9.24 T	15.19 T
Inorganics (Total) (mg/kg)						
Mercury	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
Conventional Parameters						
Lipids (%)	1.10	0.88	0.63	1.00	0.79	0.52

Blank cells indicate no analysis were performed.

ATTACHMENT K.8

CLAM TISSUE DATA

MSU Whole Body

PSR MSU Clam Whole Body Tissue Analytical Results (Wet-Weight)

Constituent — Station ID:	EB049	EB060	EB067	EB077	EB080	EB085
Sample ID:	CTI-EB49-0000	CTI-EB60-0000	CTI-EB67-0000	CTI-EB77-0000	CTI-EB80-0000	CTI-EB85-0000
Semi-Volatile Organic Compounds (ug/kg)						
2-Chloronaphthalene	24.40 U	25.00 U	24.60 U	27.70 U	26.10 U	26.60 U
2-Methylnaphthalene	24.40 U	25.00 U	24.60 U	27.70 U	26.10 U	26.60 U
Carbazole	122.00 U	125.00 U	123.00 U	139.00 U	131.00 U	133.00 U
Naphthalene, 1-methyl	24.40 U	25.00 U	24.60 U	27.70 U	26.10 U	26.60 U
Retene	24.40 U	25.00 U	24.60 U	27.70 U	26.10 U	26.60 U
Naphthalene	24.40 U	25.00 U	24.60 U	27.70 U	26.10 U	7.00 J
Acenaphthylene	24.40 U	3.10 J	4.80 J	2.80 J	2.40 J	26.60 U
Acenaphthene	24.40 U	25.00 U	3.60 J	27.70 U	26.10 U	26.60 U
Fluorene	7.10 J	25.00 U	5.30 J	27.70 U	26.10 U	26.60 U
Phenanthrene	18.70 J	15.10 J	19.30 J	12.50 J	11.00 J	16.20 J
Anthracene	28.30	19.80 J	54.00	19.10 J	14.90 J	20.30 J
Total LPAH	54.10 T	38.00 T	87.00 T	34.40 T	28.30 T	43.50 T
Fluoranthene	150.00	108.00	911.00	40.00	27.30	34.40
Pyrene	530.00	172.00	949.00	118.00	146.00	318.00
Benzo(a)anthracene	24.40 U	68.80	246.00	31.50	25.50 J	25.60 J
Chrysene	45.60	92.70	284.00	45.00	35.30	41.10
Benzo(b)fluoranthene	205.00	181.00	450.00	160.00	108.00	171.00
Benzo(k)fluoranthene	91.40	77.60	170.00	70.60	43.70	71.90
Total Benzofluoranthene	296.40 T	258.60 T	620.00 T	230.60 T	151.70 T	242.90 T
Benzo(a)pyrene	126.00	111.00	254.00	100.00	69.30	103.00
Indeno(1,2,3-cd)pyrene	29.10	27.60	61.80	29.30	20.00 J	23.60 J
Dibenz(a,h)anthracene	6.30 J	6.30 J	18.20 J	7.30 J	4.40 J	5.20 J
Benzo(g,h,i)perylene	28.40	27.70	54.70	25.70 J	20.40 J	23.70 J
Total HPAH	1211.80 T	872.70 T	3398.70 T	627.40 T	499.90 T	817.50 T
Total B(a)P equivalent	156.66 T	145.90 T	349.96 T	130.13 T	89.52 T	130.98 T

Blank cells indicate no analysis were performed.

PSR MSU Clam Whole Body Tissue Analytical Results (Wet-Weight)

Constituent	Station ID: / Sample ID:	EB049 CTI-EB49-0000	EB060 CTI-EB60-0000	EB067 CTI-EB67-0000	EB077 CTI-EB77-0000	EB080 CTI-EB80-0000	EB085 CTI-EB85-0000
Semi-Volatile Organic Compounds - LIPN (ug/kg)							
2-Chloronaphthalene		24.40 U	25.00 U	24.60 U	27.70 U	26.10 U	26.60 U
2-Methylnaphthalene		24.40 U	25.00 U	24.60 U	27.70 U	26.10 U	26.60 U
Carbazole		122.00 U	125.00 U	123.00 U	139.00 U	131.00 U	133.00 U
Naphthalene		24.40 U	25.00 U	24.60 U	27.70 U	26.10 U	2592.59 J
Acenaphthylene		24.40 U	1409.09 J	1548.38 J	1217.39 J	1043.47 J	26.60 U
Acenaphthene		24.40 U	25.00 U	1161.29 J	27.70 U	26.10 U	26.60 U
Fluorene		2535.71 J	25.00 U	1709.67 J	27.70 U	26.10 U	26.60 U
Phenanthrene		6678.57 J	6863.63 J	6225.80 J	5434.78 J	4782.60 J	6000.00 J
Anthracene		10107.14	9000.00 J	17419.35	8304.34 J	6478.26 J	7518.51 J
Total LPAH		19321.42 T	17272.72 T	28064.51 T	14956.52 T	12304.34 T	16111.11 T
Fluoranthene		53571.42	49090.90	293870.96	17391.30	11869.56	12740.74
Pyrene		189285.71	78181.81	306129.03	51304.34	63478.26	117777.77
Benzo(a)anthracene		24.40 U	31272.72	79354.83	13695.65	11086.95 J	9481.48 J
Chrysene		16285.71	42136.36	91612.90	19565.21	15347.82	15222.22
Benzo(b)fluoranthene		73214.28	82272.72	145161.29	69565.21	46956.52	63333.33
Benzo(k)fluoranthene		32642.85	35272.72	54838.70	30695.65	19000.00	26629.62
Total Benzofluoranthene		105857.14 T	117545.45 T	200000.00 T	100260.86 T	65956.52 T	89962.96 T
Benzo(a)pyrene		45000.00	50454.54	81935.48	43478.26	30130.43	38148.14
Indeno(1,2,3-cd)pyrene		10392.85	12545.45	19935.48	12739.13	8695.65 J	8740.74 J
Dibenz(a,h)anthracene		2250.00 J	2863.63 J	5870.96 J	3173.91 J	1913.04 J	1925.92 J
Benzo(g,h,i)perylene		10142.85	12590.90	17645.16	11173.91 J	8869.56 J	8777.77 J
Total HPAH		432785.71 T	396681.81 T	1096354.83 T	272782.60 T	217347.82 T	302777.77 T
Pesticides/PCBs (ug/kg)							
Aroclor 1016		12.00 U	12.00 U	12.00 U	14.00 U	13.00 U	13.00 U
Aroclor 1221		12.00 U	12.00 U	12.00 U	14.00 U	13.00 U	13.00 U
Aroclor 1232		12.00 U	12.00 U	12.00 U	14.00 U	13.00 U	13.00 U

Blank cells indicate no analysis were performed.

PSR MSU Clam Whole Body Tissue Analytical Results (Wet-Weight)

Constituent Station ID: / Sample ID:	EB049 CTI-EB49-0000	EB060 CTI-EB60-0000	EB067 CTI-EB67-0000	EB077 CTI-EB77-0000	EB080 CTI-EB80-0000	EB085 CTI-EB85-0000
Aroclor 1242	12.00 U	12.00 U	12.00 U	14.00 U	13.00 U	13.00 U
Aroclor 1248	12.00 U	12.00 U	12.00 U	14.00 U	13.00 U	13.00 U
Aroclor 1254	41.00	20.00	18.00	16.00	13.00 U	14.00
Aroclor 1260	12.00 U	12.00 U	12.00 U	14.00 U	13.00 U	13.00 U
Total PCB	41.00 T	20.00 T	18.00 T	16.00 T	13.00 UT	14.00 T
Pesticides/PCBs - LLIPN (ug/kg)						
Total PCB	14642.85 T	9090.90 T	5806.45 T	6956.52 T	13.00 UT	5185.18 T
Dioxins and Furans (ng/kg)						
2378-TCDF	0.40 U	0.40 U	0.40 U	0.40 UE	0.40 U	0.58
Total TCDF	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.58
2378-TCDD	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U
Total TCDD	0.40 U	0.40 U	1.20	0.40 U	0.40 U	0.40 U
12378-PeCDF	2.00 UE	2.00 U	2.00 UE	1.90 U	2.00 U	2.00 U
23478-PeCDF	2.00 U	2.00 U	2.00 U	1.90 U	2.00 U	2.00 U
Total PeCDF	2.00 U	2.60	2.00 U	2.40	2.00 U	2.00 U
12378-PeCDD	2.00 U	2.00 U	2.00 U	1.90 U	2.00 U	2.00 U
Total PeCDD	2.00 U	2.00 U	2.00 U	1.90 U	2.00 U	2.00 U
123478-HxCDF	2.00 U	2.00 U	2.00 U	1.90 U	2.00 U	2.00 U
123678-HxCDF	2.00 U	2.00 U	2.00 U	1.90 U	2.00 U	2.00 U
234678-HxCDF	2.00 U	2.00 U	2.00 U	1.90 U	2.00 U	2.00 U
123789-HxCDF	2.00 U	2.00 U	2.00 U	1.90 U	2.00 U	2.00 U
Total HxCDF	2.00 U	6.40	2.00 U	1.90 U	2.00 U	2.30
123478-HxCDD	2.00 U	2.00 U	2.00 U	1.90 U	2.00 U	2.00 U
123678-HxCDD	2.00 U	2.00 U	2.00 U	1.90 U	2.00 U	2.00 U
123789-HxCDD	2.00 U	2.00 U	2.00 U	1.90 U	2.00 U	2.00 U
Total HxCDD	2.00 U	9.10	5.70	2.90	2.00 U	5.70
1234678-HpCDF	3.20	3.20	3.10	3.00	2.00 U	2.70

Blank cells indicate no analysis were performed.

PSR MSU Clam Whole Body Tissue Analytical Results (Wet-Weight)

Constituent — Station ID: / Sample ID:	EB049 CTI-EB49-0000	EB060 CTI-EB60-0000	EB067 CTI-EB67-0000	EB077 CTI-EB77-0000	EB080 CTI-EB80-0000	EB085 CTI-EB85-0000
1234789-HpCDF	2.00 U	2.00 U	2.00 U	1.90 U	2.00 U	2.00 U
Total HpCDF	12.00	12.00	8.60	9.30	4.50	8.20
1234678-HpCDD	12.00	25.00	9.10	14.00	8.10	13.00
Total HpCDD	31.00	69.00	26.00	37.00	18.00	44.00
OCDF	9.20	13.00	7.30	9.10	6.40	7.70
OCDD	110.00	240.00	85.00	120.00	81.00	120.00
Total 2,3,7,8-TCDD(Equiv)	0.27 T	0.53 T	0.21 T	0.29 T	0.16 T	0.34 T
Dioxins and Furans - LIPN (ng/kg)						
Total 2,3,7,8-TCDD(Equiv)	96.85 T	243.18 T	69.12 T	130.04 T	73.21 T	126.92 T
Inorganics (Total) (mg/kg)						
Mercury	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
Conventional Parameters						
Lipids (%)	0.28	0.22	0.31	0.23	0.23	0.27

Blank cells indicate no analysis were performed.

PSR MSU Clam Whole Body Tissue Analytical Results (Wet-Weight)

Station ID:	EB087	EB104	EB106
Constituent Sample ID:	CTI-EB87-0000	CTI-EB104-0000	CTI-EB106-0000
Semi-Volatile Organic Compounds (ug/kg)			
2-Chloronaphthalene	26.00 U	26.20 U	25.90 U
2-Methylnaphthalene	26.00 U	11.40 J	25.90 U
Carbazole	130.00 U	39.80 J	130.00 U
Naphthalene, 1-methyl	26.00 U	26.20 U	25.90 U
Retene	26.00 U	26.20 U	25.90 U
Naphthalene	6.70 J	15.00 J	25.90 U
Acenaphthylene	4.20 J	3.20 J	3.40 J
Acenaphthene	5.20 J	5.00 J	25.90 U
Fluorene	9.10 J	46.90	25.90 U
Phenanthrene	30.00	100.00	16.10 J
Anthracene	95.60	1520.00	29.80
Total LPAH	150.80 T	1690.10 T	49.30 T
Fluoranthene	271.00	799.00	153.00
Pyrene	738.00	1180.00	193.00
Benzo(a)anthracene	102.00	184.00	68.80
Chrysene	127.00	260.00	89.20
Benzo(b)fluoranthene	368.00	290.00	249.00
Benzo(k)fluoranthene	118.00	118.00	86.80
Total Benzofluoranthene	486.00 T	408.00 T	335.80 T
Benzo(a)pyrene	203.00	177.00	147.00
Indeno(1,2,3-cd)pyrene	43.60	37.80	30.90
Dibenz(a,h)anthracene	11.40 J	8.20 J	7.80 J
Benzo(g,h,i)perylene	43.60	37.80	31.20
Total HPAH	2025.60 T	3091.80 T	1056.70 T
Total B(a)P equivalent	267.06 T	237.82 T	190.62 T

Blank cells indicate no analysis were performed.

PSR MSU Clam Whole Body Tissue Analytical Results (Wet-Weight)

Constituent	Station ID: / Sample ID:	EB087 CTI-EB87-0000	EB104 CTI-EB104-0000	EB106 CTI-EB106-0000
Semi-Volatile Organic Compounds - LIPN (ug/kg)				
2-Chloronaphthalene		26.00 U	26.20 U	25.90 U
2-Methylnaphthalene		26.00 U	4222.22 J	25.90 U
Carbazole		130.00 U	14740.74 J	130.00 U
Naphthalene		2680.00 J	5555.55 J	25.90 U
Acenaphthylene		1680.00 J	1185.18 J	1096.77 J
Acenaphthene		2080.00 J	1851.85 J	25.90 U
Fluorene		3640.00 J	17370.37	25.90 U
Phenanthrene		12000.00	37037.03	5193.54 J
Anthracene		38240.00	562962.96	9612.90
Total LPAH		60320.00 T	625962.96 T	15903.22 T
Fluoranthene		108400.00	295925.92	49354.83
Pyrene		295200.00	437037.03	62258.06
Benzo(a)anthracene		40800.00	68148.14	22193.54
Chrysene		50800.00	96296.29	28774.19
Benzo(b)fluoranthene		147200.00	107407.40	80322.58
Benzo(k)fluoranthene		47200.00	43703.70	28000.00
Total Benzofluoranthene		194400.00 T	151111.11 T	108322.58 T
Benzo(a)pyrene		81200.00	65555.55	47419.35
Indeno(1,2,3-cd)pyrene		17440.00	14000.00	9967.74
Dibenz(a,h)anthracene		4560.00 J	3037.03 J	2516.12 J
Benzo(g,h,i)perylene		17440.00	14000.00	10064.51
Total HPAH		810240.00 T	1145111.11 T	340870.96 T
Pesticides/PCBs (ug/kg)				
Aroclor 1016		13.00 U	13.00 U	13.00 U
Aroclor 1221		13.00 U	13.00 U	13.00 U
Aroclor 1232		13.00 U	13.00 U	13.00 U

Blank cells indicate no analysis were performed.

PSR MSU Clam Whole Body Tissue Analytical Results (Wet-Weight)

Constituent / Station ID: / Sample ID:	EB087 / CTI-EB87-0000	EB104 / CTI-EB104-0000	EB106 / CTI-EB106-0000
Aroclor 1242	13.00 U	13.00 U	13.00 U
Aroclor 1248	13.00 U	13.00 U	13.00 U
Aroclor 1254	23.00	13.00	44.00
Aroclor 1260	13.00 U	13.00 U	14.00
Total PCB	23.00 T	13.00 T	58.00 T
Pesticides/PCBs - LLIPN (ug/kg)			
Total PCB	9200.00 T	4814.81 T	18709.67 T
Dioxins and Furans (ng/kg)			
2378-TCDF	0.40 UI	0.40 UI	0.40 UI
Total TCDF	0.40 U	0.40 U	1.00
2378-TCDD	0.40 U	0.40 U	0.40 U
Total TCDD	0.40 U	0.60	0.40 U
12378-PeCDF	1.90 U	2.00 U	1.90 U
23478-PeCDF	1.90 U	2.00 U	1.90 U
Total PeCDF	1.90 U	2.00 U	2.10
12378-PeCDD	1.90 U	2.00 U	1.90 U
Total PeCDD	1.90 U	2.00 U	1.90 U
123478-HxCDF	1.90 U	2.00 U	1.90 U
123678-HxCDF	1.90 U	2.00 U	1.90 U
234678-HxCDF	1.90 U	2.00 U	1.90 U
123789-HxCDF	1.90 U	2.00 U	1.90 U
Total HxCDF	1.90 U	2.00 U	2.50
123478-HxCDD	1.90 U	2.00 U	1.90 U
123678-HxCDD	1.90 U	2.00 U	1.90 U
123789-HxCDD	1.90 U	2.00 U	1.90 U
Total HxCDD	3.40	2.00 U	6.30
1234678-HpCDF	1.90 UI	3.80	3.00

Blank cells indicate no analysis were performed.

PSR MSU Clam Whole Body Tissue Analytical Results (Wet-Weight)

Constituent	Station ID: / Sample ID:	EB087 / CTI-EB87-0000	EB104 / CTI-EB104-0000	EB106 / CTI-EB106-0000
1234789-HpCDF		1.90 U	2.00 U	1.90 U
Total HpCDF		7.70	10.00	15.00
1234678-HpCDD		15.00	9.20	23.00
Total HpCDD		41.00	23.00	59.00
OCDF		11.00	7.00	15.00
OCDD		150.00	92.00	220.00
Total 2,3,7,8-TCDD(Equiv)		0.31 T	0.22 T	0.49 T
Dioxins and Furans - LIPN (ng/kg)				
Total 2,3,7,8-TCDD(Equiv)		124.40 T	84.81 T	159.67 T
Inorganics (Total) (mg/kg)				
Mercury		0.08 U	0.08 U	0.08 U
Conventional Parameters				
Lipids (%)		0.25	0.27	0.31

Blank cells indicate no analysis were performed.

Elliott Bay Background and Bioassay Control Whole Body

PSR Elliott Bay Background and Bioassay Control Clam Whole Body Tissue Analytical Results (Wet-Weight)

Constituent — Station ID: / Sample ID:	BK001 CTI-BK01-0000	BK003 CTI-BK03-0000	CNTRL CTI-CNTRL-0000
Semi-Volatile Organic Compounds (ug/kg)			
2-Chloronaphthalene	26.30 U	25.80 U	26.40 U
2-Methylnaphthalene	26.30 U		26.40 U
Carbazole	131.00 U	129.00 U	132.00 U
Naphthalene, 1-methyl	26.30 U		26.40 U
Retene	26.30 U	25.80 U	26.40 U
Naphthalene	26.30 U		26.40 U
Acenaphthylene	26.30 U	25.80 U	26.40 U
Acenaphthene	26.30 U	25.80 U	26.40 U
Fluorene	26.30 U	25.80 U	26.40 U
Phenanthrene	7.20 J	7.20 J	26.40 U
Anthracene	26.30 U	3.70 J	26.40 U
Total LPAH	7.20 T	10.90 T	26.40 UT
Fluoranthene	13.80 J	15.80 J	26.40 U
Pyrene	22.20 J	18.80 J	26.40 U
Benzo(a)anthracene	26.30 U	25.80 U	26.40 U
Chrysene	7.90 J	10.00 J	26.40 U
Benzo(b)fluoranthene	11.40 J	18.30 J	26.40 U
Benzo(k)fluoranthene	4.80 J	25.80 U	26.40 U
Total Benzofluoranthene	16.20 T	18.30 T	26.40 UT
Benzo(a)pyrene	10.40 J	11.20 J	26.40 U
Indeno(1,2,3-cd)pyrene	26.30 U	5.70 J	26.40 U
Dibenz(a,h)anthracene	26.30 U	25.80 U	26.40 U
Benzo(g,h,i)perylene	26.30 U	5.80 J	26.40 U
Total HPAH	70.50 T	85.60 T	26.40 UT
Total B(a)P equivalent	11.59 T	13.61 T	26.40 UT

Blank cells indicate no analysis were performed.

PSR Elliott Bay Background and Bioassay Control Clam Whole Body Tissue Analytical Results (Wet-Weight)

Station ID:	BK001	BK003	CNTRL
Constituent Sample ID:	CTI-BK01-0000	CTI-BK03-0000	CTI-CNTRL-0000
Semi-Volatile Organic Compounds - LIPN (ug/kg)			
2-Chloronaphthalene	26.30 U	25.80 U	26.40 U
2-Methylnaphthalene	26.30 U		26.40 U
Carbazole	131.00 U	129.00 U	132.00 U
Naphthalene	26.30 U		26.40 U
Acenaphthylene	26.30 U	25.80 U	26.40 U
Acenaphthene	26.30 U	25.80 U	26.40 U
Fluorene	26.30 U	25.80 U	26.40 U
Phenanthrene	3789.47 J	3789.47 J	26.40 U
Anthracene	26.30 U	1947.36 J	26.40 U
Total LPAH	3789.47 T	5736.84 T	26.40 UT
Fluoranthene	7263.15 J	8315.78 J	26.40 U
Pyrene	11684.21 J	9894.73 J	26.40 U
Benzo(a)anthracene	26.30 U	25.80 U	26.40 U
Chrysene	4157.89 J	5263.15 J	26.40 U
Benzo(b)fluoranthene	6000.00 J	9631.57 J	26.40 U
Benzo(k)fluoranthene	2526.31 J	25.80 U	26.40 U
Total Benzofluoranthene	8526.31 T	9631.57 T	26.40 UT
Benzo(a)pyrene	5473.68 J	5894.73 J	26.40 U
Indeno(1,2,3-cd)pyrene	26.30 U	3000.00 J	26.40 U
Dibenz(a,h)anthracene	26.30 U	25.80 U	26.40 U
Benzo(g,h,i)perylene	26.30 U	3052.63 J	26.40 U
Total HPAH	37105.26 T	45052.63 T	26.40 UT
Pesticides/PCBs (ug/kg)			
Aroclor 1016	13.00 U	13.00 U	13.00 U
Aroclor 1221	13.00 U	13.00 U	13.00 U
Aroclor 1232	13.00 U	13.00 U	13.00 U

Blank cells indicate no analysis were performed.

PSR Elliott Bay Background and Bioassay Control Clam Whole Body Tissue Analytical Results (Wet-Weight)

Station ID:	BK001	BK003	CNTRL
Constituent — *Sample ID:*	CTI-BK01-0000	CTI-BK03-0000	CTI-CNTRL-0000
Aroclor 1242	13.00 U	13.00 U	13.00 U
Aroclor 1248	13.00 U	13.00 U	13.00 U
Aroclor 1254	13.00 U	13.00 U	13.00 U
Aroclor 1260	13.00 U	13.00 U	13.00 U
Total PCB	13.00 UT	13.00 UT	13.00 UT
Pesticides/PCBs - LLIPN (ug/kg)			
Total PCB	13.00 UT	13.00 UT	13.00 UT
Dioxins and Furans (ng/kg)			
2378-TCDF	0.40 U	0.40 U	0.40 U
Total TCDF	0.40 U	0.40 U	0.40 U
2378-TCDD	0.40 U	0.40 U	0.40 U
Total TCDD	0.40 U	0.40 U	0.40 U
12378-PeCDF	1.90 U	1.90 U	1.90 U
23478-PeCDF	1.90 U	1.90 U	1.90 U
Total PeCDF	1.90 U	1.90 U	1.90 U
12378-PeCDD	1.90 U	1.90 U	1.90 U
Total PeCDD	1.90 U	1.90 U	1.90 U
123478-HxCDF	1.90 U	1.90 U	1.90 U
123678-HxCDF	1.90 U	1.90 U	1.90 U
234678-HxCDF	1.90 U	1.90 U	1.90 U
123789-HxCDF	1.90 U	1.90 U	1.90 U
Total HxCDF	1.90 U	1.90 U	1.90 U
123478-HxCDD	1.90 U	1.90 U	1.90 U
123678-HxCDD	1.90 U	1.90 U	1.90 U
123789-HxCDD	1.90 U	1.90 U	1.90 U
Total HxCDD	1.90 U	1.90 U	1.90 U
1234678-HpCDF	1.90 U	1.90 U	1.90 U

Blank cells indicate no analysis were performed.

PSR Elliott Bay Background and Bioassay Control Clam Whole Body Tissue Analytical Results (Wet-Weight)

Constituent	Station ID: BK001 Sample ID: CTI-BK01-0000	Station ID: BK003 Sample ID: CTI-BK03-0000	Station ID: CNTRL Sample ID: CTI-CNTRL-0000
1234789-HpCDF	1.90 U	1.90 U	1.90 U
Total HpCDF	1.90 U	1.90 U	1.90 U
1234678-HpCDD	1.90 U	4.10	1.90 U
Total HpCDD	2.00	9.10	1.90 U
OCDF	3.90 U	3.90 U	3.80 U
OCDD	13.00	34.00	7.50
Total 2,3,7,8-TCDD(Equiv)	0.01 T	0.07 T	0.00 T
Dioxins and Furans - LIPN (ng/kg)			
Total 2,3,7,8-TCDD(Equiv)	6.84 T	39.47 T	2.14 T
Inorganics (Total) (mg/kg)			
Mercury	0.08 U	0.08 U	0.08 U
Conventional Parameters			
Lipids (%)	0.19	0.19	0.35

Blank cells indicate no analysis were performed.

ATTACHMENT K.9

ELLIOTT BAY BACKGROUND SURFACE SEDIMENT DATA

Elliott Bay Background Surface Sediment Analytical Results

Station ID:	BK001	BK001	BK001D	BK002	BK003	BK004
Sample ID:	SD1-BK01-0000	SD2-BK01-0000	SD1-BK01D-0000	SD1-BK02-0000	SD1-BK03-0000	SD2-BK04-0000
Constituent / Depth (cm bgs):	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm
Semi-Volatile Organic Compounds (ug/kg)						
2,4-Dimethylphenol	31.40 U		33.30 U	36.90 U	35.50 U	
2-Chloronaphthalene						14.40 U
2-Methylnaphthalene	23.70 J	19.90	15.20 J	13.50 J	35.50 U	55.70
2-Methylphenol	31.40 U		33.30 U	36.90 U	35.50 U	
4-Methylphenol	31.40 U		33.30 U	11.40 J	35.50 U	
Carbazole						4.70 J
Dibenzofuran	65.60		21.30 J	15.90 J	35.50 U	
Naphthalene, 1-methyl						36.00
Pentachlorophenol	157.00 U		166.00 U	185.00 U	178.00 U	
Phenol	31.40 U		33.30 U	94.90	35.50 U	
Retene						375.00
Naphthalene	47.70	26.20	29.80 J	36.90 U	35.50 U	232.00
Acenaphthylene	19.30 J	18.50	15.40 J	26.40 J	35.50 U	37.10
Acenaphthene	226.00	43.80	63.00	17.10 J	35.50 U	32.30
Fluorene	222.00	52.50	64.40	23.70 J	35.50 U	36.50
Phenanthrene	2220.00	542.00	635.00	138.00	35.50 U	217.00
Anthracene	728.00	164.00	200.00	80.70	35.50 U	88.80
Total LPAH	3463.00 T	847.00 T	1007.60 T	285.90 T	35.50 UT	643.70 T
Fluoranthene	2270.00	660.00	550.00	237.00	35.50 U	308.00
Pyrene	4130.00	924.00	907.00	232.00	38.10 U	395.00
Benzo(a)anthracene	1640.00	331.00	335.00	121.00	35.50 U	85.90
Chrysene	1890.00	354.00	387.00	201.00	35.50 U	131.00
Benzo(b)fluoranthene	1450.00	374.00	298.00	247.00	35.50 U	146.00
Benzo(k)fluoranthene	656.00	125.00	133.00	97.20	35.50 U	52.40
Total Benzofluoranthene	2106.00 T	499.00 T	431.00 T	344.20 T	35.50 UT	198.40 T

Blank cells indicate no analysis were performed.

Elliott Bay Background Surface Sediment Analytical Results

Station ID:	BK001	BK001	BK001D	BK002	BK003	BK004
Sample ID:	SD1-BK01-0000	SD2-BK01-0000	SD1-BK01D-0000	SD1-BK02-0000	SD1-BK03-0000	SD2-BK04-0000
Constituent Depth (cm bgs):	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm
Benzo(a)pyrene	1430.00	394.00	271.00	158.00	35.50 U	83.40
Indeno(1,2,3-cd)pyrene	669.00	190.00	136.00	106.00	35.50 U	54.60
Dibenz(a,h)anthracene	180.00	42.50	27.60 J	30.40 J	35.50 U	12.40 J
Benzo(g,h,i)perylene	654.00	213.00	128.00	98.20	35.50 U	62.10
Total HPAH	14969.00 T	3607.50 T	3172.60 T	1527.80 T	38.10 UT	1330.80 T
Total B(a)P equivalent	1994.35 T	527.60 T	377.21 T	236.97 T	35.50 UT	125.10 T
Semi-Volatile Organic Compounds - *TOCN* (ug/kg)						
2-Methylnaphthalene	3160.00 J	829.16	1617.02 J	1227.27 J		7957.14
Dibenzofuran	8746.66		2265.95 J	1445.45 J		
Naphthalene	6360.00	1091.66	3170.21 J	36.90 U		33142.85
Acenaphthylene	2573.33 J	770.83	1638.29 J	2400.00 J		5300.00
Acenaphthene	30133.33	1825.00	6702.12	1554.54 J		4614.28
Fluorene	29600.00	2187.50	6851.06	2154.54 J		5214.28
Phenanthrene	296000.00	22583.33	67553.19	12545.45		31000.00
Anthracene	97066.66	6833.33	21276.59	7336.36		12685.71
Total LPAH	461733.33 T	35291.66 T	107191.48 T	25990.90 T		91957.14 T
Fluoranthene	302666.66	27500.00	58510.63	21545.45		44000.00
Pyrene	550666.66	38500.00	96489.36	21090.90		56428.57
Benzo(a)anthracene	218666.66	13791.66	35638.29	11000.00		12271.42
Chrysene	252000.00	14750.00	41170.21	18272.72		18714.28
Total Benzofluoranthene	280800.00 T	20791.66 T	45851.06 T	31290.90 T		28342.85 T
Benzo(a)pyrene	190666.66	16416.66	28829.78	14363.63		11914.28
Indeno(1,2,3-cd)pyrene	89200.00	7916.66	14468.08	9636.36		7800.00
Dibenz(a,h)anthracene	24000.00	1770.83	2936.17 J	2763.63 J		1771.42 J
Benzo(g,h,i)perylene	87200.00	8875.00	13617.02	8927.27		8871.42
Total HPAH	1995866.66 T	150312.50 T	337510.63 T	138890.90 T		190114.28 T

Blank cells indicate no analysis were performed.

Elliott Bay Background Surface Sediment Analytical Results

Station ID:	BK001	BK001	BK001D	BK002	BK003	BK004
Sample ID:	SD1-BK01-0000	SD2-BK01-0000	SD1-BK01D-0000	SD1-BK02-0000	SD1-BK03-0000	SD2-BK04-0000
Constituent / Depth (cm bgs):	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm
Total B(a)P equivalent	265913.33 T	21983.50 T	40129.46 T	21543.00 T		17872.14 T
Pesticides/PCBs (ug/kg)						
Aroclor 1016	3.10 U	12.00 U	3.30 U	18.00 U	2.00 U	13.00 UJ
Aroclor 1221	3.10 U	23.00 U	3.30 U	18.00 U	2.00 U	13.00 UJ
Aroclor 1232	3.10 U	12.00 U	3.30 U	18.00 U	2.00 U	13.00 UJ
Aroclor 1242	3.10 U	12.00 U	3.30 U	18.00 U	2.00 U	13.00 UJ
Aroclor 1248	3.10 U	12.00 U	3.30 U	18.00 U	2.00 U	13.00 UJ
Aroclor 1254	3.10 J	14.00 U	5.00	19.00	1.20 J	150.00 J
Aroclor 1260	2.70 J	12.00 U	5.70	31.00	1.10 J	49.00
Total PCB	5.80 T	23.00 UT	10.70 T	50.00 T	2.30 T	199.00 T
Pesticides/PCBs - TOCN (ug/kg)						
Total PCB	773.33 T	23.00 UT	1138.29 T	4545.45 T		28428.57 T
Dioxins and Furans (ng/kg)						
2378-TCDF	0.49	0.51	0.62	1.30	0.42	0.40 U
Total TCDF	0.49	0.51	2.40	5.00	0.80	0.40 U
2378-TCDD	0.27 U	0.40 U	0.27 U	0.27 UI	0.27 U	0.40 U
Total TCDD	0.80	0.40 U	1.50	2.30	0.33	1.80
12378-PeCDF	1.30 U	2.00 UE	1.30 U	1.30 U	1.30 U	2.00 U
23478-PeCDF	1.30 U	2.00 U	1.30 U	1.90	1.30 U	2.00 U
Total PeCDF	1.30 U	2.00 U	3.30	14.00	1.30 U	3.30
12378-PeCDD	1.30 U	2.00 U	1.30 U	1.30 U	1.30 U	2.00 U
Total PeCDD	1.30 U	2.00 U	1.30 U	1.30 U	1.30 U	2.00 U
123478-HxCDF	1.30 U	2.00 U	1.30 UE	1.30 UE	1.30 U	2.00 UE
123678-HxCDF	1.30 U	2.00 U	1.30 U	1.30	1.30 U	2.00 U
234678-HxCDF	1.30 U	2.00 U	1.30 U	1.60	1.30 U	2.00 U

Blank cells indicate no analysis were performed.

Elliott Bay Background Surface Sediment Analytical Results

Constituent / Station ID:	BK001	BK001	BK001D	BK002	BK003	BK004
Sample ID:	SD1-BK01-0000	SD2-BK01-0000	SD1-BK01D-0000	SD1-BK02-0000	SD1-BK03-0000	SD2-BK04-0000
Depth (cm bgs):	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm
123789-HxCDF	2.10	2.00 U	1.30 U	1.30 U	1.30 U	2.00 U
Total HxCDF	2.10	2.10	3.10	17.00	1.30 U	6.30
123478-HxCDD	1.30 U	2.00 U	1.30 U	1.30 U	1.30 U	2.00 UI
123678-HxCDD	1.30 U	2.00 U	1.30 UI	5.10	1.30 U	2.00 U
123789-HxCDD	1.30 U	2.00 U	1.30 U	2.70	1.30 U	2.00 U
Total HxCDD	11.00	3.40	12.00	45.00	4.30	17.00
1234678-HpCDF	4.00	2.90	6.10	15.00	1.60	5.10
1234789-HpCDF	1.30 U	2.00 U	1.30 U	1.50	1.30 U	2.00 U
Total HpCDF	13.00	9.20	18.00	52.00	5.10	23.00
1234678-HpCDD	18.00	11.00	20.00	91.00	7.10	30.00
Total HpCDD	41.00	26.00	48.00	300.00	18.00	75.00
OCDF	10.00	6.70	15.00	44.00	4.00	24.00
OCDD	130.00	93.00	180.00	760.00	51.00	290.00
Total 2,3,7,8-TCDD(Equiv)	0.61 T	0.28 T	0.51 T	4.02 T	0.18 T	0.66 T
Dioxins and Furans - TOCN (ng/kg)						
Total 2,3,7,8-TCDD(Equiv)	82.53 T	12.07 T	55.10 T	366.27 T		95.00 T
Inorganics (Total) (mg/kg)						
Aluminum	6670.00		7540.00	7610.00	4870.00	
Arsenic	4.00 U		9.00 P	4.00 U	4.00 U	
Cadmium	0.30 U		0.30 U	0.30 U	0.30 U	
Chromium	19.50		21.60	19.40	13.00	
Copper	8.15		11.90	18.60	3.87	
Iron	17000.00		17800.00	11500.00	8000.00	
Lead	12.00 P		15.10	21.70	8.90 P	
Mercury	0.05	0.07 J	0.10	0.15	0.02	0.21
Nickel	21.00		23.10	18.20	12.80	

Blank cells indicate no analysis were performed.

Elliott Bay Background Surface Sediment Analytical Results

Constituent	Station ID: / Sample ID: / Depth (cm bgs):	BK001 SD1-BK01-0000 0 to 10 cm	BK001 SD2-BK01-0000 0 to 10 cm	BK001D SD1-BK01D-0000 0 to 10 cm	BK002 SD1-BK02-0000 0 to 10 cm	BK003 SD1-BK03-0000 0 to 10 cm	BK004 SD2-BK04-0000 0 to 10 cm
Zinc		49.60		52.50	43.90	23.30	
Conventional Parameters							
Total Organic Carbon (%)		0.75	2.40	0.94	1.10	0.29	0.70
Percent Moisture (%)		28.00		26.00	31.00	33.00	
Grain Size (%)							
>4750 microns-Fractional %		7.00		3.00			
4750-2000 microns-Fractional		9.00	6.00	8.00			3.00
2000-1000 microns-Fractional		5.00	5.00	6.00	1.00		2.00
1000-500 microns-Fractional		8.00	9.00	9.00	1.00	2.00	3.00
500-250 microns-Fractional %		29.00	29.00	29.00	12.00	17.00	11.00
250-125 microns-Fractional %		26.00	30.00	25.00	48.00	65.00	29.00
125-62.4 microns-Fractional		8.00	12.00	10.00	16.00	13.00	31.00
Total Percent Sand		76.00 T	85.00 T	79.00 T	78.00 T	97.00 T	76.00 T
62.5-31.2 microns-Fractional		1.00		1.00	5.00		10.00
31.2-15.6 microns-Fractional			1.00	1.00	4.00	1.00	3.00
15.6-7.8 microns-Fractional		1.00	2.00	1.00	3.00		1.00
7.8-3.9 microns-Fractional %		1.00	2.00	1.00	2.00		1.00
3.9-1.9 microns-Fractional %		1.00	2.00	2.00	2.00		1.00
1.9-0.9 microns-Fractional %			2.00	1.00	2.00	1.00	1.00
< 0.9 microns-Fractional %		2.00		2.00	3.00		2.00
Balance-Fractional %		2.00		1.00	1.00	1.00	2.00
Total Percent Fines		8.00 T	9.00 T	10.00 T	22.00 T	3.00 T	21.00 T

Blank cells indicate no analysis were performed.